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Editor
ROY WALDO MINER

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SECTION OF GEOLOGY AND MINERALOGY

IS "MACROEVOLUTION" REALITY?*

By DAVID M. S. WATSON†

Dr. Mayr's discussion of the evidence which paleontology affords on the nature of the process of evolution raises many interesting and important points, especially those concerned with "explosive evolution," and with the assumption of the existence of a "macroevolution," differing in its fundamental character and mechanism from the microevolution which has produced races and species.

Recent developments in genetic knowledge and theory have made it more easy to understand how populations, differing in small ways from their ancestral stock, may have been established and isolated, but the problem of the great changes, which led to the separation of large groups (phyla, classes, and orders), remains. The development of such a structure as the craniate's eye by the accumulation of a series of small changes is indeed singularly difficult to imagine, and the establishment of such a group as a phylum, distinguished by the possession of a unique structural plan with all that this implies in terms of control of individual development, is equally obscure. Thus, the idea has arisen that many of these structures may have developed abruptly by some sudden change of great magnitude, taking place in an individual development, and becoming part of the hereditary mechanisms of its successors. This is the principle of the so-called macroevolution.

Evidently, in general, paleontology can not yield any evidence on such matters. The craniate eye existed at the first appearance of craniates in the geological record, and, as its important structures are (in general) incapable of preservation, its origin must remain unknown. Since gill arches and jaws are typically present in the acanthodians, the first appearing gnathostomes, no evidence exists as to the mode of introduction into the craniate body of the branchial skeleton with its strange origin from the neural crest.

The same applies to most other classes of craniates, but the mammals are different. The first actual occurrence of any animal which is certainly a mammal is the Stonesfield slate of Bathonian (middle Jurassic age), because the well-preserved front-half of a skull, which, as *Tritylodon*, for long considered the earliest mammal, is now known to be a reptile. But, in fact, nothing is shown in the original specimen which is necessarily inconsistent with a mammalian structure, and very many characters exist in it which are of a typical mammalian kind, unknown in any reptile except its immediate relatives. Indeed, the only quality which places the English *Oligokyphus*, which is one of them, amongst the reptiles is its possession of a functional quadrate-articular jaw suspension. This, in itself, means little. What is important is that we know a series of reptiles, from the end of the Carboniferous time onward, through the Permian, and indeed to the early Jurassic, which, by direct comparison of each with its immediate predecessor and successor, can be shown to be related.

The whole story is complicated because we know so much about it, most of the material coming from the Karroo of South Africa, the only formation in the world where land-living reptiles of all sizes and habits, covering a long period of time, are found well-preserved, and in numbers comparable with those of Tertiary animals.

The general effect of the material is quite obvious. It shows us the steady change in structure of animals belonging to many different lines of descent, during which their limbs become better and better adapted to an active life, and their dentition becomes more and more elaborated and adapted to specialized feeding habits. In addition, their brains become larger, presumably to control their more advanced locomotory movements, and there is some evidence that the nasal cavity was subdivided by turbinals, and that they may well have become warm blooded. During this process of change, the quadrate (which is originally a large bone, held in place by its attachment to the squamosal, quadrato-jugal pterygoid, paroccipital process, and stapes) becomes smaller, fuses with a very reduced quadrato-jugal, loses its contact with the paroccipital, and comes to lie in a recess in the front face of the squamosal, being held there by the quadrate ramus of the pterygoid and by a newly arisen quadrate ramus of the epipterygoid.

* This paper was presented as a discussion of a paper entitled "Old Paleontological Puzzles and New Biological Concepts," by Ernst Mayr, American Museum of Natural History, New York, which was presented at the meeting of the Section on May 5, 1952, and of which no abstract has been received.

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With further reduction, the quadrate ramus of the pterygoid vanishes, and, ultimately, the epipterygoid fails to touch the quadrate, which then lies in a depression in the front face of the squamosal, being held there by pressure of the articular. During this time, the dentary bone comes to form more and more of the lower jaw, until it fails to meet the squamosal directly only by some two millimeters in a skull some fifteen centimeters long. Finally, in *Oligokyphus*, the quadrate is reduced to a minute bone, only some three millimeters high, which has become movable, but still forms the jaw articulator. Indeed, in this animal, the relation of all the parts of the skull and lower jaw to the quadrate and articular is essentially the same as the relation of the skull and lower jaw of any young pouched marsupial to those ear bones, the incus and malleus, which Reickert a hundred years ago showed were their homologues.

Thus, in this case, where many facts are available, we can trace the course of evolutionary changes in a structure, the organ of hearing, the development of which, were it not known to have occupied several millions of years, would certainly have been claimed to be a result of "macroevolution." I think that it is probable that all other cases of macroevolution are, in fact, human artifacts based on ignorance.

SECTION OF BIOLOGY

THE RELEASE AND IDENTIFICATION OF BLOOD BORNE VASOTROPIC SUBSTANCES AFTER WHOLE BODY IRRADIATION*

By THOMAS J. HALEY†

For many years, it has been postulated that the extensive cell damage produced by whole-body irradiation gives rise to circulating toxin(s) which produced some of the symptoms associated with the radiation syndrome, but experimental evidence supporting such a theory was lacking. By use of the Chambers-Zweifach[1] meso-appendix capillary-bed preparation, Haley, *et al.*[2, 3] have been able to detect circulating vasotropic substances which profoundly affect the peripheral vascular bed of the irradiated animal and which, when injected intravenously into non-irradiated normal animals, produce effects similar to those described by Zweifach, *et al.*[4-6] for physiological shock.

When rats are exposed to 600-r., acute, whole-body x-irradiation, the meso-appendix capillary bed shows a progressive decrease in epinephrine sensitivity and vasomotion during the first post-irradiation week, and a progressive increase in these same factors during the second post-irradiation week. From the nineteenth to the thirtieth post-irradiation days, the capillary responses are essentially normal. This is illustrated in FIGURE 1. It is of interest that the death rate during the first post-irradiation week is only 12 per cent, whereas it is 42 per cent during the second week. Thus, it appears that, although the animals are attempting to compensate for the large amount of damage occurring during the first week, they are unable to do so, and the results are reflected in the large increase in mortality. In so far as the leukocytes are concerned, the peripheral vascular bed reflects the overall reduction in these cells seee after whole-body irradiation. Prior to irradiation, these cells are numerous in the larger vessels, but afterwards they are so few that even single cells are difficult to find. After the fourteenth day, however, the number of leukocytes in the field of observation gradually increases as recovery begins. Petechial hemorrhages appear in the mesentery and intestines on the first day, and increase in number thereafter until massive intestinal hemorrhage occurs. This intestinal damage, which results in a large circulating-fluid loss, both blood and lymph, is of much greater significance in the overall mortality picture than the petechial hemorrhages.

In contrast to the capillary effects seen after whole-body irradiation, there are no changes in the capillary-bed responses when the rats receive 600 r. local x-irradiation to the area containing the mesenteric capillary bed. On the other hand, local irradiation in which the liver is involved results in the same type of capillary response seen after whole-body irradiation, but the vasodepression lasts for only one or two days, and there is no compensatory excitor phase during the second post-irradiation week.

* This paper was presented at the meeting of the Section on April 22, 1952, and is based on work performed under contract No. AT-04-1-GEN-12 between the Atomic Energy Commission and the University of California at Los Angeles.

† Division of Pharmacology and Toxicology, Atomic Energy Project, School of Medicine, University of California at Los Angeles.

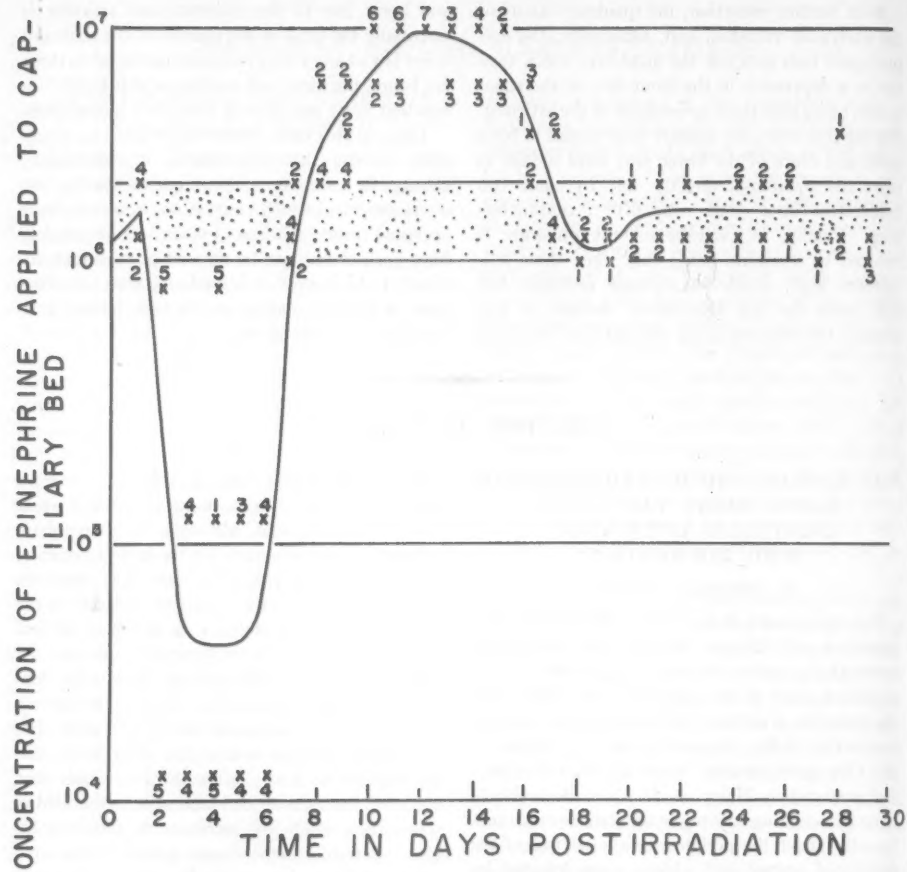
CONCENTRATION OF EPINEPHRINE APPLIED TO CAPILLARY BED
10^7
10^6
10^5
10^4
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
TIME IN DAYS POST IRRADIATION

FIGURE 1. Response of irradiated capillaries to epinephrine. Smooth line represents average response of precapillary sphincters and terminal arterioles to topical epinephrine. The numbers signify the number of animals responding to a particular concentration of epinephrine. The dotted area represents the spread of normal animal response—81 per cent responded to a concentration of $\frac{1}{2} \times 10^{-6}$. Reprinted from ref. 2.

TABLE 1

TITRATION OF VDM IN PLASMA OF IRRADIATED RATS AND DOGS

	Rat plasma		*Dog plasma*	
Post-irradiation day	*Vasodepressor doses/ml. plasma**	*Rat ferritin N equivalents, γ/ml.*	*Vasodepressor doses/ml. plasma*	*Dog ferritin N equivalents, γ/ml.*
1	0	0	>50 <500	>0.05 <0.50
2	0	0	>10 <50	>0.01 <0.05
3	>100 <500	>0.10 <0.50	>10	0.01
4	>12 <48	>0.012 <0.048	~2	0.002
5	—	—	~2	0.002

* One vasodepressor dose = 0.001γ ferritin N/ml.

Saline extracts of liver, kidney, spleen, and small intestine, intravenously administered to normal, atropinized, or diphenhydraminized rats, uniformly produce a fall in blood pressure, even when it can be demonstrated by the capillary test that the blood contains a vasoexcitor substance. These

results indicated that the vasodepressor agent is not histamine or a choline derivative, but is probably the substance "P" described by Gaddum.[7, 8]

When blood from irradiated rats is injected intravenously into normal animals, the capillary bed in these animals undergoes the same physiological changes, in response to epinephrine and in vasomotion, seen with the irradiated animals. The smooth curve in FIGURE 1 represents the changes occurring during the first and second post-irradiation weeks. Similar vasodepressor responses

TABLE 2

COMPARISON OF FERRITIN AND RADIATION VDM

Criteria	*Ferritin and rat- and dog-plasma VDM*
Major site of liberation	Liver
Aerobic enzymatic inactivation	Only liver inactivates
Oxidation	Destroys capillary activity
Reduction with cysteine	Restores capillary activity
Effect on precapillary sphincters and terminal arterioles	Decreases epinephrine sensitivity
Effect on vasomotion	Greatly decreases rate
Effect of antiserum	Inactivates
Dialysis	Does not dialyze

TABLE 3

COMPARISON OF SHOCK VEM AND RADIATION VEM

Criteria	*Shock and Radiation*
Site of liberation	Kidney
Aerobic enzymatic inactivation	Kidney and liver inactivate
Effect on precapillary sphincters and terminal arterioles	Increases epinephrine sensitivity
Effect on vasomotion	Enhances and increases rate

are obtained when the serum from dogs, subjected to radiation from an atomic detonation, is injected into test rats. However, the vasodepressor substance appears earlier, and there is no vasoexcitor phase because the dogs do not survive beyond the eighth post-irradiation day. Titration of the amounts of VDM present in the plasma of both the rat and the dog reveals that there is initially a large quantity but, as the animals recover, a progressive decrease in the quantity of VDM occurs. Composite TABLE 1 shows typical titrations.

When it had been established that the vastropic substances were blood borne, the criteria established by Mazur, *et al.*[9] for their identification were applied. TABLE 2 gives a comparison between ferritin- and radiation-produced VDM, and presumptively establishes the latter substance as ferritin.

TABLE 3 gives a comparison between VEM and the vasoexcitor seen after x-irradiation, and presumptively identifies this substance as similar to the VEM found in physiological shock.

In conclusion, it may be stated that ionizing radiation, x-rays, or radiation from an atomic detonation, give rise to a circulating toxic substance which causes a profound peripheral vascular depression. This material, which appears during the first post-irradiation week, has been shown to fit the criteria established for ferritin, a substance which has been shown to be involved in the irreversible phase of shock. The vasoexcitor material appearing in the blood of x-ray irradiated rats during the second post-irradiation week has been shown to fit the criteria established for the VEM which appears during the reversible phase of shock. The overall significance of the appearance of these two vasotropic substances during the radiation syndrome is as yet unknown, but investigations now in progress may establish their significance and means may be devised to counteract their effects.

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BIOLOGY FOR THE RESEARCH WORKER AND TEACHER*

By WALTER H. WOLFF†

A prescription for the education of the potential research worker and/or teacher in biology cannot be written. We can, however, learn much from an examination of our present inadequacies.

Our gifted pupils have often been the victims of an unwise orientation, growing out of our tendency to teach the great principles and generalizations of biology as if they constituted a closed system. In our courses of study and in our textbooks, we have often deliberately sought to show the inter-relationships existing among aspects of our subject, so that our pupils were left with the implication that a great construct exists, a conceptual scheme that would hardly need fundamental alteration.

I plead for teaching that is open-ended in the sense that it presents conceptual schemes tentatively. Biological science ought to be presented as a body of facts and principles, of which the most important thing to be said is that it will be different tomorrow. Although the facts may remain, the importance of some will diminish, that of others will grow, and new facts will be discovered, while the generalizations will certainly be altered. Some will be discarded, and new generalizations and principles will emerge from the thinking of workers in the field. Some of what we teach today, we shall certainly not teach tomorrow. Science is endlessly, irrepressibly mistaken or, at most, an approximation. Our potential research workers and teachers ought so to understand it.

The biology-teaching to which the gifted are exposed must, therefore, be persistently related to the real world of organisms and of experimentation with them. Such biology teaching is not content with verbalisms and high-level abstractions. It subjects the pupil to contact with the realities of research, the fumbling, the hesitancies, and the downright errors of the man seeking answers to questions at the borderline of knowledge. Armstrong, who pleaded for heuristic science teaching, offered guides which we have largely neglected. Here lies an opportunity to motivate the teaching of techniques, about which we have been most negligent. Every biology teacher can cite instances of pupils who have developed skills of a high order, but the systematic attempt to develop varied skills in all pupils looking toward research work or teaching is relatively uncommon in our schools.

We must guard against another great error in our teaching. We must drastically refuse to teach that which we know will later be untaught. It is damaging to our own status as teachers, and an injustice to our pupils. Let us teach as correctly as we can, or say to the pupil, "I cannot teach this; it is too difficult." Most gifted pupils will astonish us by mastering complexities of which we thought them incapable, and in the teaching of an open-ended science, it is not only easy but proper to say, "I will teach you a theory which fits some of the facts but not all. I refer you to the books on this subject for information about the other theories."

For both research workers and teachers, it is essential that a sound grasp of the social implications of our science be encouraged. It is an essential part of the growing up of the idealistic and bright adolescent that he learn to face up to the implications of some of the facts and generalizations of biology. We need not be didactic, and, in fact, we should not be. The facts of the use of natural resources in this and other continents provide play for the creative mind, and raw material for the best kind of reflective group thinking in discussion. One need not be a Malthusian to make use of the facts of population growth and of food-supply potentials to make our young people aware of basic problems in human ecology. Permit the students to draw the obvious inferences, where such inferences may be drawn.

There is an endless and restless curiosity in the best of our pupils in biology. How shall we keep it alive and help it to grow? We help it deepen and grow, I am convinced, if we refrain from providing closed conceptual schemes. We should never answer a question without showing at once that the answer does no more than lay the ground for further questions. Such questions should be made explicit, so that question-asking becomes an expected outcome of question-answering. The adolescent does not display the kind of unhesitant curiosity that is found in the very young. The adolescent is often reluctant to ask questions for fear he may seem foolish. The teacher has the duty of accepting with the utmost seriousness all the foolish questions students wish to ask. When

* This paper was presented as part of the *Symposium on Education in Biology—Its Perspectives and Horizons* at the meeting of the Section of Biology on May 2, 1952.

A paper entitled "Science, Man's Great Adventure," by Edmund W. Sinnott, Yale University Graduate School, was presented as part of the Symposium at the meeting of the Section on May 2, 1952. No abstract of this paper has been received.

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question-asking is the customary procedure, when it receives the applause of the adult leader of the group, adolescents will make this an habitual aspect of their learning experience.

We have a new need in biology teaching today, the need to teach young people how to work in teams, in which the members cooperate for a common end. As teachers, we have always had the responsibility to develop social and cooperative impulses, but the need is greater than ever today. In part, it grows out of the greater use of research teams in which the worker is primarily concerned not with personal satisfactions or aggrandizement, but with the purpose common to the group. In such a relationship, the worker is subordinate to the purpose of the group. In part, this need grows out of the urgent need of our society for men and women aware of the larger needs of the society, and desirous of serving the society's larger goals. Teachers, especially, must have a present sense of their social usefulness so that they are dedicated to the improvement of our social order.

Of course, much has been done in New York City for the gifted biology student. The record of the achievements of the public high schools and, especially, of the New York Association of Biology Teachers is so long and so great that we may be tempted to rest on it. Biologists everywhere should be better acquainted with the Biology Teachers Association. For decades, it has devoted itself to the professional improvement of its members and the betterment of biology teaching in the schools. Its committees have produced courses of study, written and rewritten endlessly, which have determined the nature of biology teaching in many parts of the country. Unique courses have been developed for the gifted, such as the course in laboratory techniques. Its volume of biological projects, "Adventures in Biology," is used by biology teachers throughout this country and abroad. "A Manual of Laboratory Exercises" is a more recent product designed to provide the teacher with useful suggestions. *The Teaching Biologist*, now incorporated in the *Teaching Scientist*, was, for years, a great professional journal, which often devoted attention to the education of the gifted. The Paul B. Mann Biology Congress, named after a great leader of biology teaching, afforded opportunities for pupils to present high-school research papers to a group of their peers. Every one of its sessions was a heartening experience for the adults who attended.

Despite these numerous and satisfying achievements, there is much that must be done. Some of the problems we face have never received the attention they deserve. It is known that gross inequalities exist within the high school system in New York City. The reduction of inequalities in plant, materials, and methods of instruction must be left to the professional staff, but they are matters of public interest. There is a tendency here, as elsewhere, to perpetuate class and status distinctions, so that the boys and girls who come from privileged homes tend to receive more privileged instruction in superior surroundings. Biology teachers are harried by lack of time and space and by budgetary limitations that produce too large classes and limit the opportunities for teachers to make their great abilities effective in the teaching of the gifted and interested pupil. We permit many potential research workers and teachers to drift into occupations that limit their social usefulness.

One major problem transcends divisional lines in the New York City school system. It is the problem of providing gifted teachers for the gifted pupil from the moment he enters the school system, until he leaves it to enter an institution of higher learning. The organization of such a program of learning is easy; but the obstacles are largely financial and personal. We find it difficult to provide an adequate education in biological science for our intellectual superiors.

There are other things we can and must do. As teachers, we must appeal more successfully to industry to provide opportunities for our pupils, in the form of scholarships and jobs. This is a debt industry owes to the whole of society and an opportunity it cannot afford to neglect. We can continue, also, such meetings as this joint meeting of the Biology Teachers' Association and the Biology Section of the New York Academy of Sciences, which provide an opportunity for teachers and biologists in the field to become better acquainted with one another and with the educational problems that are of concern to all.

YOUTH MOVEMENT IN BIOLOGY*

By WATSON DAVIS†

Understanding life in all its aspects is quite as important as understanding radar, atomic bombs, automobiles, airplanes, guided missiles, and the necessary mechanical gadgetry of our industries and homes. The biological sciences may tend to be overlooked, yet they are basic to great areas of human endeavor, such as the medical sciences, which fight disease, and agriculture, that keeps us fed and clothed.

Even for suburban youth, during the precious and formative school years, there is not the opportunity there once was to know about nature, and there is less drive and prestige toward natural history. There is less chance to observe fascinating problems of the life of insects, the habits of snakes, the blooming of flowers, the growing of crops, and the activity of animals in the fields, forests, streams, and oceans. There is a need for a renaissance of biology, which, in fact, has already begun, and is based upon discovery by youth that biology (in fact, all science) is fun. It is a great quest for knowing the living world. We can join in by making it possible for them to recapitulate the hard-won intellectual evolution of the scientific world as quickly and effectively as possible, without damage to the natural urge to explore and find out for themselves. One of the prime dangers is the deadly didactic approach of uninspired and routine teaching that rubs the bloom off the budding interest of young students, and misleads them into concluding that the course known as biology is not real, interesting, and useful, and not more worth taking than some "snap" course.

The club or project approach to science for youth is participated in by over a third of a million boys and girls in 15,000 science clubs in almost every city, county, and town of America, and many places abroad. The young scientist goes at his experiments with educationally helpful enthusiasm. Working at his hobby, he often learns more than in formal class. This is the essence of the science-club method, the experimental educational method, the learn-by-working-on-what-you-want-to method.

Early experience and acquaintanceship with the biological sciences on the part of youth, from the age of about twelve when they enter junior high school, is provided by the science clubs, science fairs, and other such project activities, integrated, but not formalized in the class work.

The youth science movement has two objectives, to supply (1) talented research workers to solve the continuing problems of our civilization; and (2) people who know and appreciate the methods and possibilities of science.

This youth movement, in which Science Service has given cooperation from the national level, is of major importance. Failure to provide opportunities throughout the world for youth activity in science, including biology, will be a crime against the future.

Biology, in its broad aspects, provides exciting fields for science youth endeavors, as shown by typical examples of experience in the local and national science fairs and the national science talent search.

Nine out of the 40 projects of the winners of the eleventh Science Talent Search for the Westinghouse Scholarships were in the field of biology. In the two previous science talent searches, there were a larger number, in each case 11 out of the 40. These very rigorously selected projects are undoubtedly among the most advanced that are done by high school students. For that reason their titles will be illuminating.

In the eleventh science talent search, the biological projects were: soil-less culture of seedlings; bacterial content of milk by plate count; effect of female hormones on roosters; animal protein factor in animal growth; sporulation of lager yeast; determining number of organisms in a bacteriological culture; effects of hyper-estrogenic activity in the hamster; plankton-importance and migration, and a study of intelligence in hamsters. Similarly, the subjects in biology in the tenth science talent search were: ecology of a pond: a study of life in inland waters; hobbies in mammalogy: graphs of research on rats; insect flight: analysis and practical applications; topography, flora, and scenic beauty of the Sierra Nevada; induced longitudinal fission in hydra; the Pacific pond turtle and other chelonians; study of chromosomes and cell division recorded in microphotographs; preliminary investigation of the gaseous secretion of the confused beetle; the winter birds of a second-growth oak-hickory forest; the microscope, the camera, and the one-celled animal blepharisma; field trip collections; effect of temperature on the fresh water fish, centrarchidae. The ninth science talent search biological project titles were: species found and equipment used in

* This paper was part of the Symposium at the meeting of the Section on May 2, 1952.

† Science Service, Washington, D. C.

a survey of fishes off Coney Island, New York; alternative pathway mazes to observe learning in ants; a census of the birds breeding in 25 acres of Long Island woodland; galls—plant cancers: *Solidago* galls and tannin extraction apparatus; research on protozoa, photomicrographs; life history and experimental control of the Colorado potato beetle; hypertension in the rat with reference to man; nervous system of cat; the effects of light on ascorbic acid (vitamin C); mutations of *Drosophila melangogaster* from x-radiation; the gram stain—one of the standard laboratory procedures used for identifying bacteria; a method by which pure cultures of bacterial species are studied and identified.

The national science fair is a collection of exhibits that have won in local science fairs. In the third national science fair held in 1952, 16 out of the 42 exhibits were in the field of biology. From the following titles of these exhibits, may be judged the quality as to subject matter and content covered: molds from soil; why allergy tests and shots seem misleading; the effects of reduced pressure on plant life; our wonderful heart; anatomical models; comparative skeletal anatomy; comparison of life processes in plants and animals; biological collections; lepidoptera; zoology with emphasis on entomology; blood, our amazing life-stream; the multi-colored world of microorganisms; the life of the three-spot *Gourami*; research on some studies and properties of chlorophyll; a survey of the ectoparasites of the white-footed mouse; and morphology of internal organs of animals.

The preponderance of physical science, that is evident in the science talent search and the national science fair, is reflected to a large extent in the choice of the professional careers by young scientists. There are, of course, more physical scientists and engineers at work in our nation than biologists, and agricultural and medical scientists.

One of the questions that may be raised is whether this is a useful situation, and what causes so many young scientists to choose careers in physical sciences, rather than the biological sciences.

Discussion has been carried on in the rather effective forum which is afforded by correspondence between the winners of the science talent search, numbering 40 each year. These young scientists are from 15 to 29 years of age. They are in colleges, universities, and technical schools all over the United States, or recently graduated from them. Their opinions are illuminating.

One group of their opinions was that the physical sciences are more glamorous and more highly publicized and, for that reason, more students choose careers in the physical sciences. Another group of views contended that the physical sciences are more exact and, therefore, more frequently chosen. Still others credited early influences in their lives toward the physical sciences, pointing out that the experiments that are most easily done are those in the physical sciences. In the opinion of some, it is easier to start a hobby in physical science, than in biology. Teaching emphasis, in many opinions, is more directly on the physical sciences, than on the biological sciences. A smaller number of the science-talent-search winners felt that judging procedures of the science talent search favor those headed for the physical science careers, with the science aptitude test possibly acting as a filter. According to one opinion, the talents for biological science are, perhaps, less mathematical in nature, and, for that reason, more difficult to discover. Another reason is that there are more opportunities in the physical sciences, in the opinion of many of the winners.

These opinions are from a rather small sample of the scientific population, but they may, in the aggregate, throw some light upon the way in which scientists think about the fields of possible researches, and the value of careers.

Whether there exists now in the distribution of manpower, a proper balance between the physical and biological sciences, can be argued. Certainly, for the present, there seems to be a larger demand for physicists, chemists, and engineers, than for biological and medical scientists. This situation is perhaps overbalanced by the fact that engineers, in many cases, occupy the same relationship to research scientists that physicians and agriculturalists have to biological research scientists.

The usefulness of science technology to the world will be better served if the youth of the world has a large opportunity for experiencing many fields of science and technology, before it is committed educationally to a more limited field of their choice. This is one of the great objectives of the educational experience of both the classroom, and the science clubs. To the extent that it succeeds in our educational picture, we shall have more creative workers in science and technology in the future.

PHYSIOLOGY OF THE EXTERNAL SECRETION OF THE PANCREAS*

By J. E. THOMAS†

Important considerations in the physiology of the digestive glands are the nature of the secretion that they produce, the conditions under which they produce it, and the mechanisms which they utilize in doing their secretory work. In this discussion, these problems will be dealt with in consecutive order as they apply to the pancreas.

Pancreatic Juice

Pancreatic juice consists essentially of a salt solution containing varying amounts of protein. The principal salts are sodium bicarbonate and sodium chloride. The relative concentration of these two salts varies with the rate of secretion, the bicarbonate directly, and the chloride inversely. When expressed in milliequivalents, the total salt concentration (that is, the sum of the concentrations of chloride and bicarbonate), remains fairly constant and approximates the salt concentration of the blood.[1, 2, 3] Other salts are present in small amounts. Potassium and calcium ions, and traces of phosphate may be detected. The sodium–potassium ratio is the same as that of the blood plasma, but the calcium and phosphate are in lower concentration than in the blood. The total osmotic activity of the juice is the same as that of the blood, when the two are measured simultaneously in the same animal.[4]

The protein of pancreatic juice comprises a mixture of enzymes. Three of these are well known, trypsin, lipase, and amylase; but by suitable methods of analysis, it is possible to show the presence of some eight or ten separate proteins in the juice, each of which possibly represents a different enzyme.[5] For example, what was formerly called trypsin has been shown by Kunitz and Northrop[6] to comprise at least two enzymes, which they called trypsin and chymo-trypsin, respectively. Both digest native protein, but they differ in specificity, solubility, crystalline form, *etc.* Recent work by Waldron[7] in our laboratory suggests the possibility of two amylases, a suggestion strongly supported by the electrophoretic analysis recently reported by Komarov[5] and his co-workers. Since the number of known enzymes falls short of the number of separate components believed to be in the juice we may look forward to the discovery of additional enzymes.

Pancreatic Stimuli

In some species, the pancreas secretes continuously and, in others, only intermittently; but, in all animals, the secretion is augmented during digestion. The increase is caused by specific stimuli, associated with the presence of food in the gastrointestinal tract. Except for a brief and relatively unimportant episode of secretion during the act of eating, associated with the sight, smell, and taste of food, the stimulating effect of food arises only within the small intestine. By analogy with the three well known phases of gastric secretion, we may say that there is a cephalic phase and an intestinal phase, but no gastric phase of pancreatic secretion.

The substances that act as stimuli in the intestine comprise the various constituents of the gastric chyme. They include water,[8] acid,[9] products of protein digestion,[10] products of starch digestion,[11] fat, and products of fat digestion.[12, 13] When used singly, each of these stimuli produces a characteristic type of pancreatic juice. For example, acid causes a watery secretion, low in enzymes, while the food products tend to increase the enzyme concentration. Fats, in particular, have this effect, which may be one reason for restricting fats in patients who are susceptible to recurrent attacks of pancreatitis.

The mechanism of action of the various stimuli is an exciting problem, which is far from solution at the present time. Nervous and hormonal mechanisms are available. The best known of the hormones is secretin, which was discovered just 50 years ago by Bayliss and Starling,[14] when they prepared an acid extract of the intestinal mucosa which, when injected intravenously into a dog, caused the pancreas to secrete. Secretin affects chiefly the output of water and salts from the pancreas. Although enzymes are always present in the juice, their concentration is not increased by purified secretin. In addition, the purest secretin available moderately increases the volume of bile secreted by the liver.

Crude intestinal extracts, such as Bayliss and Starling prepared, increased both the fluid and the enzyme output from the pancreas. In 1943, Harper and Raper[15] succeeded in separating from the crude extract the substance responsible for increasing the enzyme output, which they called pancreozymin. There are, therefore, two in-

* This paper was the first in a Symposium of four papers entitled "Studies on the Pancreas," presented at the meeting of the Section of Biology on May 12, 1952.

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testinal hormones which act on the pancreas, one to increase the water and bicarbonate secreted, and the other to increase the enzyme output.

Secretin seems to be chiefly involved in the effects on the pancreas of acid in the intestine, but conditions governing the release of pancreozymin are not so well defined. Wang and Grossman[16] have recently shown that the output of enzymes, from a denervated transplant of the pancreas, is increased by the presence in the intestine of the stimuli mentioned previously, including acid and water. Presumably, this indicates release of pancreozymin by these stimuli. A difficulty, in accepting this hypothesis *in toto*, arises from our own experience,[17] with these stimuli, which indicates that in the intact pancreas the effects of some of them are diminished by atropine. This drug, in the experience of Harper and Raper, and of Grossman does not affect the response to pancreozymin. Clearly, the question requires further study.

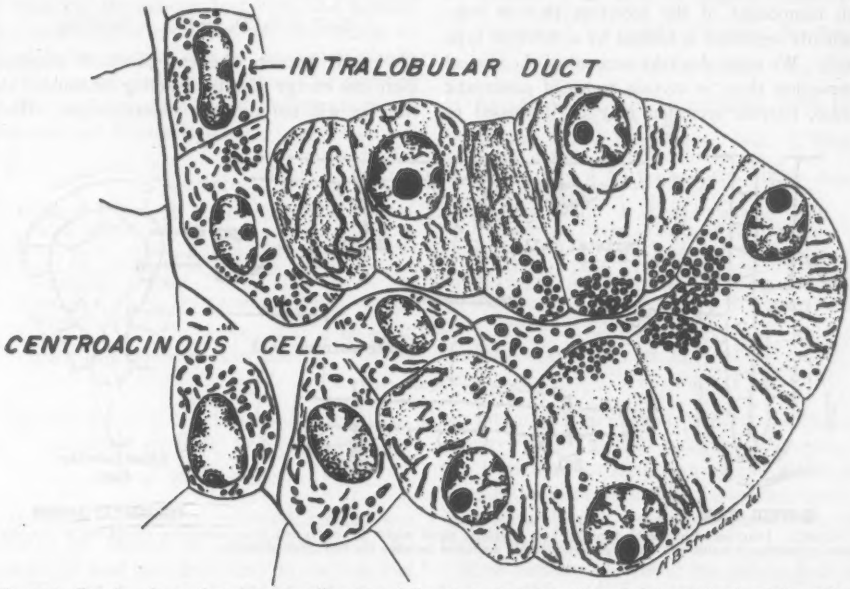

FIGURE 1. Drawing of a section of a pancreatic acinus of the guinea pig showing the various types of cells mentioned in the text. (Slightly modified from R. R. BENSLEY. 1912. Am. J. Anat., 12: 297.

The Mechanism of Pancreatic Secretion

Secretion of enzymes by the pancreas involves two distinct processes: (1) synthesis within the cell of the enzymes or their precursors, and (2) discharge of these enzymes from the secretory cells into the ducts. Synthesis is a continuous process believed not to be subject to nervous or humoral regulation, and to be controlled only by the laws that govern chemical equilibria in general. The synthesized material appears within the acinous cells as zymogen granules, which accumulate in the resting gland until they come to occupy most of the available space within the cells.

Under the influence of appropriate stimuli the zymogen granules within the cells diminish in number and in size. At the same time, enzymes appear in the secretion. The exact method of transfer is not known but, at some point in the process, the granules dissolve in the surrounding fluid for they are seldom encountered as such within the ducts. Stimuli such as HCl and secretin, which produce a watery secretion with a low enzyme content, have little effect on the granules, while stimuli which call forth secretion rich in enzymes deplete the granules and may, if they act over a long period of time, leave the cells almost clear.[18]

It has long been assumed that the inorganic constituents of the juice are secreted by the same cells that produce the enzymes, namely the acinous cells, but the fact that fluid secretion and enzyme

secretion are separately regulated raises a thoretical objection to this view. It is practically a law of physiology that cells respond to stimulation with a characteristic type of functional activity regardless of the nature of the stimulus. It would be difficult to imagine a cell that could give one response to one stimulus and a totally different response to another type of stimulus. In the other digestive glands, about which we have more information, each component of the secretion that is independently regulated is formed by a different type of cell. We must also take account of the clinical observation that, in certain types of pancreatic disease, enzyme secretion may be depressed or absent, while secretion of fluid and bicarbonate remains normal.[19, 20] On the other hand, in glands injured by alloxan, fluid secretion may be subnormal, while enzymes are secreted normally. This latter observation, reported by Grossman and Ivy,[21] contains a hint as to a possible solution of the problem. Histological examination of the glands which failed to respond normally to secretin showed no injury to the acinous cells, but the cells of the intralobular ducts appeared abnormal; in particular, they exhibited vacuolization. The intralobular-duct cells are continuous with the centroacinous cells that line the alveoli, and they are identical with these cells in their cytological structure (see FIGURE 1).

Even if we knew which cells secrete water and bicarbonate, we would still be confronted by many unsolved problems. We have little knowledge of how the bicarbonate is separated from the blood plasma, or even whether it comes from the blood or from the metabolic CO_2 of the cells. Much more attention has been given to secretion of HCl by the stomach, and the information gained may eventually help us with the pancreas for there is a certain analogy between the secretion of HCl by the stomach and secretion of bicarbonate by the pancreas. If we take the simplest possible equation for the formation of HCl from the blood plasma we get:

$$NaCl + H_2CO_3 \rightarrow HCl + NaHCO_3.$$

Obviously, because the end products represent more free energy than the reacting substances, the reaction will not progress spontaneously. Work must be done by the secretory cells in one way or another, but, whatever the mechanism, and whatever intermediate steps may be involved, the end products will be as indicated.

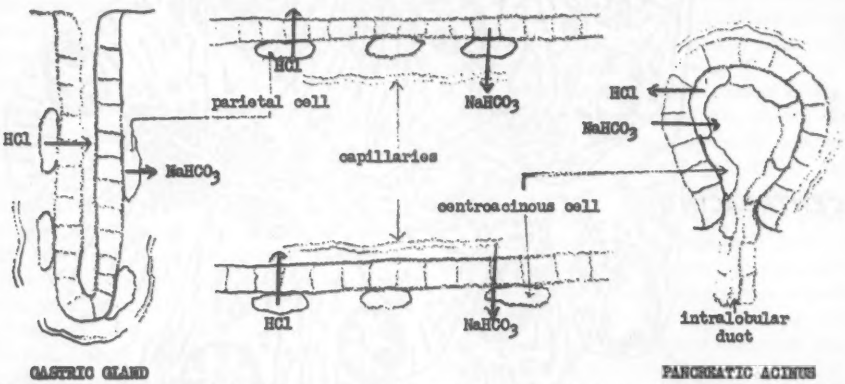

FIGURE 2. Diagrammatic sketch showing how a gastric gland might be converted into something resembling a pancreatic acinus by turning it inside-out, and suggesting certain analogies between the two types of glands.

In the case of the gastric glands, the HCl is discharged into the lumen of the ducts, and the bicarbonate into the blood. If, by some trick, we could turn the cells around so that their luminal border faced the blood stream, and the base of the cell the lumen, we should be secreting bicarbonate into the lumen, and acid into the blood. This relationship is indicated in FIGURE 2. Drawn in this way, another analogy appears: The centroacinous cells have the position that the parietal cells would have if the gastric glands were turned inside out. This is certainly not evidence that there is any functional relationship between these cells and in fact, it may, be just an amusing coincidence. In this situation, the centroacinous cells would seem to bee too poorly situated in

relation to the blood supply to do any serious secretory work, but this objection does not apply to the cytologically identical intralobular-duct cells which have been seriously considered as a possible source of the fluid and bicarbonate of the juice.

On this admittedly slender basis, I venture to make the following suggestions:

That the pancreatic acinus has some resemblance to a gastric gland in reverse.

That the intralobular-duct cells, and possibly the centroacinous cells, may be functionally related to the parietal cells of the gastric glands.

That the intracellular mechanisms for secretion of HCl by the stomach and of bicarbonate by the pancreas may be identical.

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THE PRODUCTION OF EXPERIMENTAL LESIONS IN THE PANCREAS*

By M. WACHSTEIN†

The era of experimental pancreatic research was initiated by Mering and Minkowsky who accomplished total pancreatectomy in the dog, and were thus able to prove the fundamental importance of the pancreas in carbohydrate metabolism.[1] Later it was discovered that, under certain experimental conditions, extracts of the anterior lobe of the pituitary would damage the Langerhans islands and cause not only transient, but even permanent diabetes.[2] The chance discovery by Dunn, Sheehan, and McLetchie,[3] that alloxan was a potent diabetogenic substance, has proven to be of great importance. This simple and reliable method of producing permanent diabetes in various species has made feasible many interesting contributions in this field of research.[4] Beside alloxan a number of related compounds, *e.g.* alloxantin and dialuric acid, were found to have a similar effect, while a host of chemically related and unrelated drugs were found to lack diabetogenic activity.[4] With special staining techniques, it has been demonstrated that alloxan selectively destroys the beta cells of the Langerhans islands, while the alpha cells remain intact and frequently became more numerous.

More recently Patterson[5] has shown that dehydroascorbic acid, an oxidation product of ascorbic acid, will produce diabetes in rats. The related dehydroisoascorbic and dehydroglucoascorbic acids have a similar effect.[6] Dehydroascorbic acid, which is structurally related to alloxan, is known to occur on the animal body[5] while circumstancial evidence suggests that even alloxan may occur in man under normal conditions.[7]

That the pancreas contains appreciable amounts of zinc is well documented.[8] This metal can be demonstrated histochemically in the Langerhans islands of the pancreas.[9] Prompted by this knowledge, Kodata investigated the influence of various chemicals known to precipitate *in vitro* heavy metals including zinc.[10] He found that, among those examined, oxine (8-hydroxyquinoline) and dithizone (diphenylthiocarbazone) produced permanent diabetes in rabbits due to their selective destruction of the beta cells of the Langerhans

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islands. The histochemical zinc reaction in the Langerhans islands of animals exposed to the action of these chemicals is considerably reduced.[10, 11]

Hydropic degeneration of the beta cells in Langerhans islands, a change which, under certain conditions, is reversible, has been observed under various experimental conditions, *e.g.*, after administration of pituitary extracts, after partial pancreatectomy and after the administration of large doses of glucose.[12] It may also occur in animals with alloxan diabetes of long duration, as well as in rabbits manifesting a diabetic-like state following the prolonged administration of cortisone.[13] It has recently been demonstrated that such hydropic degeneration is due to infiltration by glycogen.[12] The hydropic degeneration known to occur in the Langerhans islands of patients dying in diabetic coma[14] may likewise be due to infiltration by glycogen.[13] A more consistent change in the Langerhans islands of patients suffering from severe diabetes is the marked diminution in the number of beta cells.[15]

Great interest centers about the recent findings of Kadota and Midorikawa.[16] In the furtherance of their previous studies, these investigators found several chemicals which react with heavy metals to have a specific destructive action upon alpha cells of the Langerhans islands, while the beta cells remain undamaged or show only slight changes. Following the intravenous administration of diethyldithiocarbamate and of potassium ethylxanthate to rabbits, there occurs, after an initial transient phase of hyperglycemia, a period of profound hypoglycemia which will not respond to the administration of glucose. These findings would lend support to the contention that the alpha cells are connected with the production of a substance with a specific hyperglycemic action.[17]

The most impressive lesion of the pancreas encountered in human pathology is the sudden destruction of large parts of the exocrine portion of this organ, with a subsequent escape of pancreatic enzymes causing extensive fat necrosis. It is remarkable that the majority of those who survive the acute disease make a complete anatomical and functional recovery. On the other hand, focal chronic inflammation and fibrosis is a fairly common finding in the pancreas of patients with only histories of insufficient food intake, *e.g.* those with nutritional liver cirrhosis. No attempt will be made to review the various, more or less successful, experimental procedures that were used in various animal species to produce, predominantly by mechanical means, an acute hemorrhagic pancreatic necrosis, paralleling that found in man. It should only be mentioned in this connection that complete obstruction of the excretory ducts will lead to atrophy of the entire exocrine portion, with the Langerhans islands remaining intact.

The possible significance of nutritional and infectious factors in the genesis of pancreatic disease in man has been brought to the fore by two recent discoveries. Ethionine (α-amino-γ-ethyl-thiobutyric acid), a presumed antagonist of methionine, will produce fatty livers in female but not in male rats after a single injection.[18] However, the same dose produces pancreatic necrosis in both sexes,[19, 20] and, it was further noted, most regularly in rats on a protein-free diet.[21] Incidentally, on the same diet, there occurs acute renal necrosis, restricted to the distal portion of the proximal convoluted tubules. This was found predominantly in the male animals.[22, 23] Although considerable pancreatic fibrosis was found in some animals five or six days after an injection of ethionine, the lesions disappeared quite rapidly. If, however, the ethionine is given as a 0.5 per cent food supplement, hepatic as well as pancreatic lesions are produced with great regularity, as has been shown by Koch-Weser and Popper.[24, 25] The occurrence of the damage can be completely prevented by the simultaneous administration of methionine. On the other hand, even far-advanced hepatic and pancreatic lesions will almost completely disappear following the withdrawal of the damaging ethionine. Thus, the pancreas presents a remarkable ability for complete functional and anatomical restitution even after very severe structural changes.

While such ethionine injury speaks for possible nutritional factors which may be of importance in the causation of pancreatic pathology, the recent discovery of Pappenheimer and his coworkers[26] has demonstrated that severe pancreatic lesions can be caused by a filterable virus. It was found by these workers that certain strains of the Coxsackie virus can produce diffuse acute hemorrhagic necrosis in the pancreas of adult mice. In animals which survived the acute phase, marked chronic fibrosing pancreatitis was observed.

In summary, the subject of the selective destruction of the beta cells of the Langerhans islands, with the subsequent production of permanent diabetes by various agents, has been briefly re-

viewed. Among those substances are alloxan, dehydroascorbic acid and 8-hydroxyquinoline. Other agents, *e.g.* diethyldithiocarbamate, selectively damage alpha cells. Various experimentally induced conditions may cause a reversible change of beta cells, commonly called hydropic degeneration. This is apparently due to the intracellular deposition of glycogen. Concerning the exocrine portion of the pancreas, ethionine, a supposed methionine antagonist, not only damages the kidney and the liver, but produces extensive destruction of the pancreas. Complete restoration of this organ, however, will occur following the withdrawal of the drug. Finally, destruction of the pancreas in the mouse can be caused by certain strains of the Coxsackie virus.

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AN EVALUATION OF PANCREATIC-FUNCTION TESTS IN THE DIAGNOSIS OF PANCREATIC DISEASE*

By DAVID A. DREILING, SR.†‡

Precise diagnosis of pancreatic disease has been hampered by the lack of quantitative laboratory procedures for the determination of external pancreatic function. This paper is an analysis of the more important tests of pancreatic function for the purpose of estimating their reliability in the diagnosis of pancreatic disease. The procedures to be considered are (1) examination of the blood for pancreatic enzymes; (2) chemical analysis of the feces; and (3) examination of the duodenal contents.

Examination of the Blood Enzymes

In 1929, Elman[1] demonstrated that acute pancreatic-duct obstruction results in serum-amylase elevations. The blood amylase rises rapidly within the first hours of pancreatic affection, reaches a maximum within 24 hours, and then falls to normal by the 72nd hour of illness.

One might expect that these amylase elevations would constitute an ideal diagnostic test. This has not been the case because patients do not always present themselves at the onset of symptoms. Thus, a primary elevation may be missed and, therefore, a normal amylase does not exclude pancreatic disease; nor can an elevated blood amylase be taken as an absolute indication of pancreatic disease. It has been repeatedly noted that high amylases may occur in acute cholecystitis,[2] choledocholithiasis,[2] biliary dyskinesia,[3–5] penetrating duodenal ulcer,[5] and after morphine injection.[6, 7] Another disadvantage of the serum-enzyme-concentration test is that the level of enzyme can not be correlated with the extent of pathology nor with the prognosis.

The evanescence of amylase elevations has led to the development of provocative blood enzyme tests.[3, 8–20] In these procedures, a pancreatic secretogogue is given parenterally, following which

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‡ With the technical assistance of Miss Alice Klein, B.S.

the blood enzyme level is determined at intervals for several hours. The stimulants used, either singly or in combination,[3, 20] are secretin,[8, 9] prostigmine[10, 13] mecholyl,[11, 16] urecholine,[11, 18] and morphine.[19, 11, 17, 19] The blood-enzyme response depends upon the ability of the gland to secrete enzyme, the patency and development of both the main and accessory duct systems, and the functional state of the sphincter. Despite initial promising reports, this approach has not been successful in the hands of most investigators.[3, 11, 16, 18, 20] The experience at Mount Sinai Hospital comprises 200 studies in patients without and with pancreatic disease, using combinations of secretin, mecholyl, urecholine, and morphine. The responses obtained in these patients have not correlated with the known state of pancreatic function.

TABLE 1
SECRETIN-RESPONSE DATA OF 81 PATIENTS WITHOUT PANCREATIC DISEASE

	Total volume		HCO_3, *max.*	*Amylase secretion*		
				Concentration,	*Total quantity*	
	ml.	*ml./kg.*	*meq./l.*	*u./ml.*	*units*	*u./kg.*
Range	107–492	1.8–7.6	80–140	0.9–17.6	309–2366	6.1–34.6
Mean	191	3.2	108	4.3	867	14.2
S.D.*	56.3	0.6	7.7	1.8	213	3.1
V_c†%	30	18	7	37	25	21

* S. D. = Standard deviation.
† V_c = Coefficient of variation.

TABLE 2
RANGES OF NORMS DERIVED FROM SECRETIN-RESPONSE DATA

Total volume, ml./kg.	HCO_3, *max. meq./l.*	*Total amylase, u./kg.*
2.0 or more	90 or more	6.0 or more

Examination of the Feces

Examination of the feces involves chemical analysis for nitrogen and fat content. In order to obtain quantitative data, the patient is fed a fixed diet for three days. Stool analysis gives information not only as to the completeness of digestion but also as to the extent of absorption. High unsplit-fat and low fatty-acid content means incomplete enzymatic digestion. Low unsplit-fat with high fatty-acid content indicates incomplete absorption. Although theoretically these concepts are sound, in practice, however, there is an additional variable, *intestinal transit time*, which affects both digestion and absorption. When the transit time is rapid, digestion and absorption are so interfered with that a positive differentiation between pancreatic disease and nonpancreatic digestive disorders is impossible. Thus, steatorrhea may be seen in sprue, ileitis, ulcerative colitis, *etc.*[15]

That patients with chronic pancreatitis display changes in stool composition is not to be doubted. The excellent studies of Dornberger[21] and others[22, 23] have demonstrated this. The observed changes however, are not specific and not diagnostic. Amongst 47 patients with chronic pancreatitis (to be reported elsewhere) only eight (16%) had stool abnormalities. In Dornberger's series of 20 patients with pancreatitis, there were six (30%) whose stool analyses fell outside normal ranges. Five of these six patients had advanced disease. These findings and the reports of others[15, 24] make it clear that stool abnormalities occur only in the advanced stages of pancreatic disease. This latter fact, supported by the observations of Brunschwig[25] and other surgeons who have performed major pancreatic resections with surprisingly minimal digestive disturbance in their patients, has given rise to the impression amongst clinicians that the pancreas has tremendous reserve capacity. Unfortunately, this concept has been interpreted by some to mean that tremendous damage to the pancreas is required before there is an alteration of pancreatic secretion. The concept of tremendous reserve digestive capacity is correct and, therefore, analysis of the stool cannot be used as a quantitative test of pancreatic function. I believe the concept of tremendous reserve secretory capacity to be incorrect, because, as will be shown, the pancreatic function can be studied quantitatively by examinations of the duodenal drainage.

Examination of the Duodenal Drainage

The first successful quantitative studies of duodenal drainage were conducted by Hammarsten, Lagerlof, and Agren[26] using a purefied extract of the hormone, secretin. Other investigators,[27–41] employing the technique of the secretin test, have been impressed by its clinical potentialities. In order to demonstrate the value and limitations of secretin-test data in the diagnosis of pancreatic disease, illustrative material from 800 secretin-test studies will be presented.

TABLE 3
SUMMARY OF SECRETIN-RESPONSE DATA IN 61 CASES WITH PANCREATIC TUMORS

		Average pancreatic response			*Numbers and percentages of normal responses*		
	No. of cases	*Volume, ml./kg.*	*HCO_3, meq./l.*	*Amylase, u./kg.*	*Volume*	*HCO_3*	*Amylase*
Location of tumor:							
Diffuse	12	1.1	52	4.5	0(0%)	1(8%)	3(25%)
Head	30	1.4	80	5.0	2(6%)	14(47%)	11(37%)
Body	14	1.6	86	5.3	2(14%)	7(50%)	6(43%)
Tail	5	3.8	108	13.0	5(100%)	5(100%)	5(100%)
Normals:							
Average	81	3.2	108	14.2	—	—	—
Lower limit	81	2.0	90	6.0	—	—	—

TABLE 4
SECRETIN-RESPONSE DATA OF 41 PATIENTS WITH ACUTE PANCREATITIS AND 47 PATIENTS WITH CHRONIC PANCREATITIS

	Average pancreatic response			*Numbers and percentages of normal responses*		
	Volume, ml./kg.	*HCO_3, meq./l.*	*Amylase, u./kg.*	*Volume*	*HCO_3*	*Amylase*
Acute pancreatitis (41)	2.5	96	11.7	33(80%)	28(68%)	30(73%)
Chronic pancreatitis (47)	2.1	48	5.5	26(56%)	2(4%)	18(38%)
Normals (81), average	3.2	108	14.2	—	—	—
Normals (81), lower limit	2.0	90	6.0	—	—	—

A secretin test is performed on patients in the fasting state. The duodenal tube is positioned under fluoroscopic control. The 1.0 units of secretin/kilo is injected intravenously and the duodenal drainage is collected at 20-minute intervals for 80 minutes. Total volume, maximum bicarbonate concentration, and total enzyme content characterize the pancreatic response to secretin.[38–41]

Normals. The statistical data obtained from 81 control patients is summarized in TABLE 1. The normal ranges are calculated from the mean, using a two sigma interval. The derived values are given in TABLE 2.

Patients with Pancreatic Cancer. A summary of the secretin response data of 61 patients with pancreatic cancers is listed in TABLE 3.[41] Secretion abnormalities are most consistently seen in the volume data. The greatest deviations occur in diffuse pancreatic cancers. Tumors of the head and body produce lesser changes in secretion. Tail neoplasms do not affect pancreatic secretion.

The alteration of the secretin response in pancreatic cancers is a quantitative one, and depends upon the site and degree of pancreatic-duct obstruction. The potency of the juice is diminished in the extensive lesions because of the vast amount of parenchyma destroyed, and also due to the chronic inflammatory reaction that occurs in association with the cancer.

The limitations of the secretin test in the diagnosis of pancreatic cancer are clear. Tumors which do not cause major pancreatic-duct obstruction cannot be detected. In the diffuse cancers, the secretin response data, which includes reduction in both quantity and potency of secretion, cannot be differentiated from the responses in the end stages of chronic pancreatitis.

Patients with Pancreatitis. The secretin response data of 88 patients with pancreatitis are summarized in TABLE 4. In the patients with acute pancreatitis, the data indicate that the secretin test may or may not be entirely normal. If the responses are correlated with the interval of time between the onset of symptoms and the

performance of the test, it becomes evident that the pancreatic secretion returns to normal ranges within the first week of illness. The secretin test has therefore only limited value in the diagnosis of acute pancreatitis. It may be used, however, prognostically, in that the persistence of abnormal secretion following subsidence of illness is suggestive of permanent parenchymal damage.

The data in patients with chronic pancreatitis show marked consistent depression of the bicarbonate concentration. Volume and enzyme secretion are affected to a much lesser degree. Whether this dissociation means a differentiation of function between the acinar and intralobular duct cells[42] or a differential loss of function[43] is not clear. It certainly does not imply that, in pancreatitis, the ability to produce a potent buffering juice is more consistently and characteristically lost than the ability to produce an enzyme-potent secretion. The prominence of bicarbonate secretion defect is caused by the use of the specific stimulus, secretin, which augments bicarbonate formation but does not influence enzyme elaboration.[44]

The lack of sensitivity of the secretin test to the quantitative changes in enzyme secretion, which must be present in chronic pancreatitis, is a remediable defect of the secretin test. Attempts to correct this have been made by combining the secretin stimulus with insulin[43, 45] mecholyl,[46] and urecholine.[47] A more satisfactory solution would be the incorporation of a standardized pancreozymin in the secretin preparation.

Summary

An analysis of laboratory procedures used in the diagnosis of pancreatic disease leads to the following conclusions:

(1) Blood-amylase elevations, when present, are valuable in confirming a diagnosis of acute pancreatitis. No correlations can be made on a quantitative basis. The results of the provocative blood enzyme tests are inconclusive.

(2) Chemical analysis of the stool furnishes information concerning the completeness of digestion and absorption, but it can not be used as a reliable quantitative index of pancreatic function.

(3) The secretin test yields quantitative data of external pancreatic secretion. Its value in the diagnosis of acute pancreatic disease is limited by the rapidity with which pancreatic secretion returns to normal ranges. Pancreatic cancers and chronic pancreatitis can be diagnosed from characteristic alterations in the secretin-test responses. In the advanced stages of both diseases, these responses are no longer diagnostically distinct. A combined secretin-pancreozymin test may resolve this difficulty, and appears to offer the best type of quantitative procedure for study of pancreatic secretion and diagnosis of pancreatic disease.

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THE HYPERGLYCEMIC FACTOR OF THE PANCREAS*

By I. J. PINCUS†‡

For almost 30 years, it has been known that certain pancreatic extracts contain, in addition to insulin, a substance which can elevate blood sugar. A number of reviews[1, 2, 3, 4, 5] have summarized our knowledge of this substance called the hyperglycemic-glycogenolytic factor or HGF. Our purpose is to discuss briefly certain aspects of this problem, and to speculate on possible clinical and other implications.

Although extensive studies have been performed in recent years, it has not been conclusively shown that this substance functions physiologically, nor that it is derived from the alpha cells. A considerable body of evidence, however, suggests that both are true.

Crude insulin preparations have a biphasic effect on blood sugar with an initial rise followed by a fall. The commercially obtainable insulins contain HGF in varying amounts as a contaminant. The NOVO laboratories and the Eli Lily laboratories have prepared insulin relatively free of this substance. Preparations of HGF possessing no insulin activity are also available.

The factor which causes a rise in blood sugar has been prepared from normal pancreas, pancreas rendered fibrotic by duct ligation, fetal-calf pancreas, and from the pancreas of animals previously treated with alloxan to destroy the beta cells (which produce insulin). Some investigators have also prepared this factor from gastric and duodenal mucosa. It is not present in extracts of parotid gland, muscle, kidney, or liver. From this, we conclude that the material is not derived from acinar tissue, which is not yet functional in the fetal calf, and which has been destroyed after ligation of the pancreatic ducts; nor does it appear likely that this substance is derived from the beta cells, which have largely been destroyed after alloxan administration. There are a number of cells in the pancreas from which this substance may have been extracted. One cell, with the attributes of a secretory cell, to which no function has been ascribed is the alpha cell. Similar cells have been described in gastric and duodenal mucosa.

The factor we are considering has been found to elevate blood sugar by causing a liberation of glucose from the stores of liver glycogen. Following a 72-hour fast, when the hepatic-glycogen stores have been depleted, there is only a minimal rise in blood sugar after the administration of this substance. Following pancreatectomy, if the animal is well maintained by insulin and diet, a rise in blood sugar will be effected, but, if acidosis is permitted to intervene, the same animal will show a much smaller rise. Following hepatectomy, no significant effect of this substance was observed on blood sugar.

Sutherland and his co-workers[4] found that liver slices incubated in suitable media would liberate glucose more rapidly if this material were present. They have studied the mechanisms of this action and find that a hepatic phosphorylase is activated.

* This paper was the fourth in a Symposium of four papers entitled "Studies on the Pancreas," presented at the meeting of the Section of Biology on May 12, 1952.

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Foa and his co-workers[6] suggest by cross-circulation experiments that the blood from the pancreatic vein of alloxan-diabetic dogs may elevate blood sugar. More recently, Bornstein and his co-workers[7] have found increased amounts of a substance causing hyperglycemia in the pancreatic-vein blood of cats treated with growth hormone.

A considerable number of observations suggest that a pancreatic factor may play a role such as that ascribed to the HGF. Young[8] demonstrated that the diabetes produced in the dog by anterior-pituitary extracts frequently required large doses of insulin in order to maintain normal blood-sugar levels and that, without insulin, the blood sugar levels were exceedingly high. He also called attention to the fact that such animals could survive for a long period of time without insulin. After pancreatectomy in such a dog, the blood sugar was lower than previously, the insulin requirement less, and, if insulin was withheld, the animal rapidly developed ketosis and died. Dragstedt[9] made similar observations in dogs made diabetic by partial pancreatectomy, and Thorogood and Zimmerman,[10] in a series of experiments on dogs made diabetic with alloxan, showed similar phenomena and also that the external pancreatic secretion was not involved in this effect. These observations suggest that the pancreas may produce a factor that raises blood sugar and causes a greater insulin requirement. Also, they suggest that such a factor may decrease the acidosis present in the pancreatectomized animal. Mirsky[11] has suggested that the decreased acidosis might be due to differences in hepatic-glycogen stores in the alloxan-diabetic animal.

We[12] were particularly impressed by the differences in acidosis in the alloxan-diabetic and pancreatectomized animals we have observed. Because of this, in a series of studies in our laboratories, we studied free and total cholesterol, phospholipids, and fatty acids in the blood and liver, as well as acetone bodies in the blood of normal animals and of animals which had been pancreatectomized, in response to intermittent injection or constant infusion of preparations of the HG factor. We have been unable to satisfy ourselves in these studies that the preparations we used produced a change in any of these constituents. These studies are being continued.

Observations in humans have led to results which suggest that a pancreatic factor other than insulin may influence metabolism in health as well as in disease. Many patients with diabetes require doses of insulin in excess of 100 units daily. Following pancreatectomy, the required insulin dosage is rarely in excess of 40 or 50 units and, in several instances where the patients were diabetic before surgery, the insulin requirement was actually decreased after pancreatectomy. These latter observations are difficult to evaluate since pancreatectomy produces many effects which are attributable to a disturbance of digestion caused by insufficiency of the external pancreatic secretions. Since no conclusive evidence of adrenal or pituitary hyperfunction has been found in diabetic patients requiring large amounts of insulin, we must admit the possibility of the HG factor playing a role in the human.

The effect of administering this substance to humans has been studied.[13, 14, 15] We found that the hyperglycemia factor, derived from insulin administered to normal people and to people with a stable form of diabetes, provoked a similar small rise in blood sugar. When this material was administered to a small number of patients with a labile form of diabetes, the rise in blood sugar was much greater, suggesting that possibly these patients either responded differently because they had less of this material present, or that their glycogen stores were larger or different from that found in stable-diabetic or normal persons.

The evidence that the HG factor is produced by the alpha cell is less clear. Sutherland[16] found that the distribution of HGF corresponds roughly with the distribution of islets in the pancreas. Snedecor and MacGrath[17] have suggested differences in the alpha cells in mice with varying insulin sensitivity.

Kadota[18] found that after administering diethylthiocarbamate there is a rise in blood sugar followed by a profound hypoglycemia, at which time the alpha cells are largely destroyed. This pattern of response very closely resembles, in reverse, what occurs after alloxan administration, and suggests that the alpha cell produces HGF.

McQuarrie and his co-workers[19] have studied a number of infants with persistent hypoglycemia. They noted that pancreatic tissue obtained from these infants contained few alpha cells, and suggested that this may account for the low blood-sugar levels observed. Of interest are the observations of Hard,[20] who found that the newborn rat has but few or no alpha cells, but that these generally develop after three or four days. Is it

possible that a similar condition may be present in some human infants where a failure of development of these cells produces a deficiency state, characterized by an unopposed insulin effect?

Froelich, *et al*[21] have reported a case of hypoglycemia in which an absence of alpha cells was found, further suggesting the clinical possibility of such a deficiency state.

It has been suggested by the Coris that Von Gierke's disease, which is characterized by high levels of liver and/or myocardial glycogen, is not a single entity, but results from one of several different defects. In some instances, a deficiency in the HG factor may account for some of the manifestations which have been described. Such a patient, whom we have studied with Dr. Paschkis, exhibited a remarkable and prolonged hyperglycemia after the administration of this material. Two others with similar clinical manifestations have shown no significant elevation of blood sugar after the administration of the HG factor.

Isolated instances of islet-cell tumors associated with diabetes have been described, but the cell type in these tumors has not been determined, nor have such tissues been extracted and studied for their content of the HG factor.

It seems to us that many more observations are in order and that many more studies must be made. Pancreatic extracts should be prepared and assayed for insulin and HGF content in patients with different types of diabetes and other conditions. Suitably prepared tissues should be carefully studied for alpha- and beta-cell relationships. This should be a fruitful field of investigation, and one which may help explain the various syndromes noted above, as well as the inconsistent phenomena observed in human and experimental diabetes.

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*SECTION OF MATHEMATICS AND ENGINEERING**

SOME ASPECTS IN THE CONTROL OF AIR POLLUTION IN INDUSTRIAL AREAS†

By NICHOLAS V. FEODOROFF‡

The dispersion and spreading of dust and smoke from stacks have long been recognized as extremely serious problems of air pollution. An attempt will be made therefore to present some of the means of air purification in industrial centers.

The presence of foreign matter in the air does not necessarily "pollute" it; but the air is considered polluted when the concentration of pollutance becomes excessive and therefore dangerous to health and property.

The American Standards Association sets certain definitions for the pollutants present in the air[3] for example: dust, solid particles of organic matter which do not diffuse in the air but settle

* A paper entitled "Polarized Infra-Red Spectra of Proteins and Steroids," by Ralph Halford, Columbia University, was presented at the meeting of the Section of Physics and Chemistry on May 6, 1952. No abstract has been received.

† This paper, illustrated with lantern slides, was presented at the meeting of the Section on May 16, 1952.

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by gravity; fumes, particles generated by condensation from the gaseous state; mist, suspended liquid particles; vapors, gaseous forms of substances; gases, formless fluids.

Almost unlimited quantities and species of polluting matter may be present in natural air, but they are not necessarily serious. On the other hand, industrial pollution is dangerous. It is dangerous to health and property to have high concentrations of chemical pollutance emitted from the stacks. The emission of such pollutance is the result of incomplete combustion processes. The concentration of matters consists of such things as flyash, smoke, fumes, *etc.*, which may all be the result of the use of improper fuel and/or faulty firing. Assuming that the fuel burned is of excellent quality, the burning of this fuel may not necessarily be complete. The ideal combustion efficiency of the fuel may not be achieved because the factors that control the combustion, and therefore the emission of flyashes and "gases," demand proper firing installation. These factors are gas velocity, turbulence of combustion, dust-collecting and re-injecting mechanism, and properly understood meteorological conditions. There is also the human factor, one of the most difficult involved in the efficient operation of firing equipment. The design and maintenance of firing installations, therefore, require cooperation of properly trained men in the applied sciences of fluid mechanics and aerodynamics, thermodynamics, combustion engineering, mechanical engineering, and meteorology (prevailing winds, direction, velocity, moisture, *etc.*). The aerodynamical aspects of the design of stacks has been partially investigated through special studies. The question of the proper shape and height of the stack is of great importance. Long Island studies for Consolidated Edison by New York University pointed out that to keep the plume 100 feet above the ground, the stack-gas velocity should be four times the selected velocity of thirty feet per second (the highest wind speed), or 120 feet per second.[7]

How far the polluting matter settles from the source of emission is shown by the following example: Assuming the stack height is 200 feet, the large particles, from size 100 mesh (140 microns) to 325 mesh (45 microns), fall within a distance of less than a mile, depending upon conditions; but the particles from 43 to 11 microns may be carried to a distance of 10 miles or more. The smoke with particles a fraction of a micron is carried for many miles from the source of emission and, therefore, its effective destructive zone is incomparably large. It is these gases, which settle at very great distances, that produce the most undesirable effect.

According to studies, such gaseous elements as sulphur, chlorine, and carbon and their derivatives may be emitted from the firing equipment. The effect of sulphur and its derivatives, the most unpleasant of all gases, has been the subject of much study for many years.

Plants and vegetation have been very much affected by the emitted pollutance. This is not only because the sunlight necessary for growth has been reduced tremendously, and because the soot, deposited on the leaf surface in the form of a tarry coating, chokes the plants while the sulphuric acid deposits destroy the living cell; but especially because most important long-range destructive factor is the sulphuric acid deposited in the soil. It destroys the necessary bacteria and other organisms living in the soil and, in this way, diminishes or destroys its fertility.[1]

One need not go far to find the destructive action of the emitted pollutance. Looking over Harlem from Morningside Heights (New York City) in the early morning at the break of dawn, one can see clearly the silhouette of the Triborough Bridge and other structures miles and miles away; but, by 7:00 A.M., when New York has awakened, the smoke issues from chimneys, darkens the sky, and the heavy, gray, unhealthy-looking "smog" (combination of smoke and fog) covers Harlem like a tremendous blanket. Soon one is unable to see even Morningside Avenue only a few blocks away. Only the afternoon breeze may uncover the city from this smog.

Looking at the trees and grass near by, you will see pale, gray-looking, early-aged trees and vegetation. Needless to say, it costs the people of the City of New York millions of dollars per year to maintain the parks and provide proper nourishment. Look at the statues, monuments, and buildings. They were very beautiful in their early days, but now they have been destroyed, corroded by acids. A very conservative estimate of the maintenance cost is about twenty dollars *per capita* per year for New York City, Chicago, St. Louis, and other large cities.

Go to mining and smelting centers, and you will see for miles the dark-gray coating lying on the ground. There are few, if any, trees, and very

often no grass. Even the most resistant weeds do not survive under these conditions.

The prevailing public opinion, that air pollutants emitted from firing equipment are not dangerous, meaning that direct death is almost nil, has to be taken with "a grain of salt". It may be true that direct death as a result of "artificial" pollutance is very rare, but studies show that, in London, in 1922, during the smoke and fog season, the number of deaths increased alarmingly (see TABLE 1). This increase in deaths of almost 100% in four weeks has been attributed to air pollution.

TABLE 1

Week ending	*Death from respirator diseases in London*[1]
Nov. 4, 1922	113
Nov. 11, 1922	149
Nov. 18, 1922	182
Nov. 25, 1922	238

The various gases, emitted in large quantities, may shorten the life of a human being. Such gases as lead, arsenic, and mercury affect health very much. Such pollutants as granite, steel, iron, and others are very irritating. The common disease in the blast industry is silicosis.

Let us not underestimate the importance of air as "food" for our organisms. If, during a day, an individual uses as much as five pounds of food, he inhales 35 pounds of air This amounts to 3000 gallons of air per day, or 35 pounds of air per day, *per capita!*

Technologically, industry has developed certain types of dust collectors. Some of them may be mentioned here: (1) wet scrubbers; (2) cloth filters; (3) mechanical collectors; (4) electrical precipitators. Wet scrubbers are easily corroded by sulfur oxides and cloth filters are affected by temperature.[6] Therefore, these two types are limited in their uses. The other types, the mechanical collectors and electrical precipitators, are the ones most used by industry.

In some types of mechanical collectors, the pollutants are washed by water emitted from properly designed nozzles. The flyashes and other pollutants which pass through the water layers are wetted and washed into a specially designed sludge-discharge tank. Some dust collectors, known as "cyclones," work on the principle of centrifugal force.

The Electrical Precipitators. The principle of the operation of electrostatic precipitators, known as Cottrell precipitators, is a high voltage impressed between two electrodes, one being known as a discharge electrode, and the other as a collector electrode. The high-voltage field produces a Corona effect.[5] The flowing air or gas is ionized. If we imagine a metallic tube in which a central conductor is set; then, because of ionization of gas media, we will receive an ionic, or what is known as a convection, current. If the conductor is charged negatively, and the metallic container positively (high voltage difference), we shall have a stream of negative ions moving to the container and positive charges moving from the container to the conductor. Therefore, the ions "electrify" the particles of dust which are precipitated in the apparatus. The Cottrell system utilizes the central conductor as a negative emission electrode and the walls of the metallic container as a positive collecting electrode. Such types of apparatus require very elaborate systems, because, to obtain the Corona effect, it is necessary to supply a comparatively high direct-current voltage. Also, systems using an ionization chamber require considerable power.

The particles of dust (ash) admitted to the apparatus are electrified negatively and attracted to the positive collecting electrode. The collected dust (dust collected in positive tube electrode) is released from time to time into the collector by a mechanical "vibrator." During operation, the discharge electrode becomes coated by a layer of burned particles. This reduces the efficiency of the operation, and the discharge electrode must therefore be cleared. Some electric precipitators are set in such a way that dust particles are first ionized (pre-ionization chamber), and then admitted into the apparatus, where they are attracted to the electrode of the opposite polarity. Such is the principle, for example, of the electrofilter of the Westinghouse precipitators. The The particles of dust or gas are first ionized at high voltage of 8000 volts direct current and are then attracted to the collector electrode which is 13,000 volts.

There are many variations of the Cottrell system in use. These types of electrofilters "attract" (precipitate) particles, such as dust, ash, *etc.* All these electrofilters or electroprecipitators have one disadvantage: they do not destroy the gases. From the point of view of health this is the most unpleasant factor of air pollution.

Dr. Yadoff[8] has developed the method of electromagnetic turbulence. Briefly, the system

is this: an A.C. or D.C. current flows through a central conductor, which is insulated from the outside metallic case. This current, of relatively low magnitude, does not heat the conductor to incandescence but creates an electromagnetic field. A high-voltage direct current is impressed on the outside collecting electrode, which produces the electric field. The interaction of these two fields, set up in this fashion, produces a destructive effect on the gases.

Dr. Yadoff's paper explains clearly how electromagnetic turbulence is produced, and how the free electrons are acted upon by the resultant field. Free electrons contacting or meeting gaseous molecular–chemical combinations upset their internal electrostatic balance. This results in freeing atoms which are easily attracted to the collecting electrode.

The method of Dr. Yadoff, in the development of which I have taken an active part from the beginning, can be applied independently, or in combinations as an auxiliary to existing systems.

The one very important factor in effective purification is to deal properly with the viscosity of gas. The viscosity always introduces difficulty in effective precipitation. By Stokes law, one may find the force necessary to overcome the viscous effect. This force is $F = 3\pi\mu dv$, where μ is viscosity. This force is provided through electromagnetic turbulence so that it separates the chemically combined gases into their original elements. The experimental work shows this effect.

Three major factors are necessary for a human being to exist. The first is soil, the second is water, and the third, air. This great land of ours is in a very bad condition. The great sites of the richest soil (the Mississippi Valley, for example) are depleted because of improper use. With the destruction of the soil, forests and other vegetation are disappearing. The great water basins are also destroyed through pollution. There are almost no fish, which means a very limited amount of food is in the rivers. The land cannot support the people, the majority of whom are seeking new places to live. The migration of many people to other places has been a necessity. The third factor necessary for human life: air. The air is also contaminated. During wartime, because of conditions, pollutants in great quantities have filled the air and their destructive effects have been very great.

The pollution in certain areas, and the subsequent destruction of property, are moving faster than efforts to control them. For example, the number of smelting foundries in this country is about 5000, and only 50 of them have full or partial control of pollutants. Four thousand nine hundred and fifty units operate without any control (In Bridgeport, for example, flame issues directly into the air from very low stacks). There are numerous city, county, and other smoke-control organizations, but their efforts, however great they may be, are not sufficient to cope with the problem. There must be coordination among all such agencies and with the people at large to establish effective control on a nation-wide scale.

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SECTION OF PSYCHOLOGY

PERSONALITY CHARACTERISTICS OF THE FACIALLY DISFIGURED*

By THEODORA M. ABEL†

Facial disfigurement, as well as other forms of physical handicap, may evoke a variety of social attitudes reflecting disapproval, fear, superstition, and prejudice, sometimes manifested directly, sometimes in disguised forms of discrimination and hostility. This awareness stems from the growing number of war casualties and civilian accident cases, and from the cultural emphasis placed on facial beauty and physical attractiveness for employment, marriage, and success in general.[2]

It is true that each facially handicapped person has his own characteristic ways of adjustment to his deformity and to the pressures of the society in which he lives. But many of his attitudes largely reflect the values his society places on deformity, and which his parents in some way have absorbed and transmitted to him either directly or by implication. If he has been a disabled individual from birth, the attitudes which his parents assume toward him and toward his specific deformity will play a determining role in the molding of his personality structure. If he becomes handicapped when he gets older, he will respond to his disability (as he would to any frustration, trauma, or abuse) on the basis of his particular kind of personality structure, which will include attitudes and feelings toward deformity which he has in some way accumulated during his life history.

During 1949–1951, an interdisciplinary project was carried on at the New York University College of Medicine for the purpose of studying the psycho-social and psychiatric aspects of facial disfigurement and plastic surgery.‡ Patients, who came voluntarily for corrective surgery, were interviewed and tested. They represented both the mildly and severely disfigured, including those whose deformity was present at birth or shortly thereafter, and those who became disfigured in childhood, adolescence, or adulthood as the result of accident or disease. Several kinds of disfigurement were presented, such as congenital absence of one or both ears, hare-lip, facial paralysis, absence of nose, scarring from burns, oversized nose, cancer sequelae, *etc.*

All of the 74 patients studied, whether they were of mild or severe deformity, had the feeling that their disfigurement was a deterrent to successful living, and many complained that they were in some way discriminated against, either at work or in social situations. To the outsider, these complaints appear justified in the case of severe deformity, but in the case of mild disfigurement they seem unrealistic and irrational.

As part of the project, we were concerned with an exploration of the personality make-up of the patients as revealed through projective techniques. In giving the tests, we had several objectives in mind. We wanted to discover if facially disfigured individuals had any consistent modes of response. We also wished to learn whether the severely and the mildly deformed responded in differential ways, and what differences in the responses before and after surgery were discernible in each group, and between the two groups. Finally, we were interested in determining some of the individual differences among the patients.§ In the present paper, we shall limit ourselves to a comparison of mild and severe disfigurement, using for this purpose the results of the human-figure drawings and of the Rorschach given before, and again after surgery or, in cases where surgery was not undertaken after a period of time.

The First Rorschach Test. The Rorschach was given to 55 adult subjects, 25 males and 30 females, who voluntarily requested corrective surgery. Several kinds of facial disfigurement were included, as described in the introduction. The subjects were classified into two groups according to degree of severity of disfigurement. Judgments were made by five members of the project acting in concert. The groups agreed upon were mild–moderate, designated Group A, and marked–gross, designated Group B. Evaluations were made on the basis of esthetic reference.

* This paper, illustrated with lantern slides, was presented at the meeting of the Section on May 19, 1952.

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‡ This research project, which was entitled "The Psychological and Sociological Aspects of Facial Deformities and Plastic Surgery," was done under the Department of Psychiatry and Surgery. The project was supported by a grant from the National Institute of Mental Health, United States Public Health Service, was initiated by Frances Cooke Macgregor, Coordinator, and was under the direction of John Marquis Converse, M.D. The author is particularly indebted to her colleague, Serena Weissmann, for her collaboration in this study. The results of this project will be published in 1952.[1]

§ The tests used were the Rorschach; the Behn-Zulliger; human figure drawings; and, in some cases, the Szondi; the Thematic Apperception Test; the Children's Apperception Test; the Harrower Most Unpleasant Concept; and the Bender Gestalt Test.

Among the less severely disfigured (Group A), there are 29 subjects, 11 males and 18 females. In Group B, the more severely disfigured, there are 26 subjects, 14 males and 12 females. The age range is 17–62 years. In both groups, about ⅔ of the subjects are under 36; of the remaining ⅓, Group B shows a more scattered distribution than Group A.

With regard to intelligence, education, socio-economic, and ethnic data, Groups A and B are more similar than dissimilar. In both groups, there tends to be a greater concentration at the upper intelligence and education levels, and in professional and skilled occupations. Between 60 and 90 per cent of both groups are native-born Americans, and most of these are of second or third generation. Slightly more than 50 per cent in both groups are now, or have been, married. Group A, however, has a very much greater number and proportion of divorced subjects than Group B.

Both the mildly and severely facially disfigured show underproductivity in responses to the Rorschach blots. They give fewer answers than would be expected from an unselected group of equivalent age range, intellectual level and socio-economic background.* However, Group A, the mildly disfigured, are more productive than Group B, the severely disfigured. Both groups are also limited in the use they make of creative imagination and fantasy, as indicated by their reduced number of human-movement responses. More than one-half of our subjects give either no human-movement response or only one. Again, the more mildly deformed show greater facility in this area than the more severely disfigured.

When we consider solely the frequency with which human movement is given in Card III (where human movement is so easily and popularly projected), we find again that Group A perceives movement more readily than Group B. There is also further evidence of Group A's relatively greater facility with this determinant. A greater number of Group A than of Group B gives one or more human-movement responses to additional cards besides those which are most likely to elicit human movement (Cards II, III, and VII). All this gives added strength to the notion that Group A is somewhat freer than Group B in its use of creative imagination, although it is again emphasized that both groups are limited in this area.

In general, our patients show more potentiality for spontaneity than might be supposed from their reduced response productivity and low human-movement level. They have considerable sensitivity to animal movement, with an excessive emphasis on this determinant as compared with human movement. They are also very responsive to color, more than two-fifths giving two or more responses where color predominates over form. The reverse direction, or form-color, is more usual for mature adults of comparable intelligence, but only one-fourth of our patients gives two or more form-color responses.

The color responses reveal specific differences between Group A and Group B. More subjects in Group A than in Group B give two or more form-color responses; but, on the other hand, Group A shows less control over color than does Group B, since more of them give a minus quality to their form-color responses than those in Group B. Continuing this trend, more subjects in Group A than in Group B give two or more color-form responses, but again with less control, for the answers often have a minus quality. Group A maintains this tendency to greater acting-out of feelings, as also indicated by its higher frequency of pure color responses.

The majority among both groups, as a whole, show greater extraversive strivings than introversive, since they give more color than movement responses. The differences in elaborating this extraversive trend, however, suggest that the more mildly disfigured, Group A, are more poorly integrated emotionally than Group B, especially when dealing with strong stimulation. The overweighted color responses for both groups suggest that these patients have a pervasive doubt of their ability in self-acceptance, and, in making constructive use of fantasy, the mildly disfigured show greater ambivalence and conflict in this regard. We also found that the Group A members seem to be particularly concerned about themselves, as evidenced by the number who give a greater frequency of anatomy responses.

The Second Rorschach Test. About three-fifths of our adult patients were available for a retest, either after surgery was partially or totally completed, or after a period of time when no

* Due to the small number of cases, the results are to be considered as trends only, since they do not have sufficient statistical reliability. For a more detailed account of the statistical data see "Facial Deformity and Plastic Surgery," Ch. 4.[1]

surgery had been performed. The time interval between the first and second tests varied from three to sixteen months, with the median time interval at nine months. In discussing the results of the second test on only 31 patients, we wish to emphasize that any trends, noted in the comparison of the mildly disfigured (now 13 cases) and the severely disfigured (now 18 cases) are very much open to chance influences. Nevertheless, we investigated the differences between Rorschach I and Rorschach II for each group compared with itself and with the other, as well as for both groups taken as a whole.

If we compare the results for the smaller number of patients who received two Rorschachs, we do not find any marked differences between the first Rorschach and the retest for each group. The reduced size groups will be designated as AR (the mildly disfigured who were retested) and as BR (the severely disfigured who were retested). We found that Group AR continues the tendency of the original Group A to be more productive in both Test I and Test II. This bears out what we suggested earlier, that the more severely disfigured, Group B, tend to be more repressed than Group A. Both groups yield more animal-movement than human-movement responses, but the severely disfigured Group (BR) give relatively more animal than human movement in comparison with the mildly disfigured group (AR) in both Tests I and II. Group AR, like the original larger Group A, gives to some extent more anatomy responses in Tests I and II than does Group BR.

These few differences between Group AR and Group BR again suggest that the more severely disfigured are more repressed than the mildly disfigured, but, at the same time, they are less self-preoccupied and perhaps more self-contained in a healthy, although immature fashion, giving more animal movement and less anatomy than do the mildly disfigured. These results confirm what we found earlier in our comparison of the larger Groups A and B.

When we compare what the 31 patients in Groups AR and BR did as a total group, the differences between Tests I and II are more apparent. In the second test, the group as a whole (AR plus BR) exhibits greater control over feelings than in Test I. This is shown by the following modes of response: In Test II there is an increase in the percentage of pure form responses; there is a shift from color toward human-movement responses; the responses move from color-form to form-color; and, finally, there is a reduction in pure-color and in color responses with poor control (both in form-color and color-form).

We can summarize these findings by saying that, when the patients are retested, they give, as a group, better controlled Rorschach patterns. These patterns are like those of individuals who are somewhat better adjusted or in balance according to Rorschach theory. It is suggested that these patients who returned for the retest might have benefited either from surgery and/or from the fact that there were people interested in them, on whom they could count, and who gave them support and encouragement, but it is also pointed out that we feel the follow-up period after surgery is too brief to draw significant conclusions. Eight patients were given a third Rorschach a year following the second test, but this number is too small to make group comparisons, and the results can only be used in individual-case studies.

Human-Figure Drawings. In our search for factors in human-figure drawings that might be characteristic of our facially disfigured patients, and that might differentiate the mildly from the severely deformed, we did not attempt to make an exhaustive study of various aspects of the drawings, as we did with the Rorschach protocols. Instead, we studied the drawings to see in what ways our patients dealt with the face and its features. This part of the investigation was also limited to a study of the same-sex drawings by the patients, since it is generally accepted that individuals are more likely to identify themselves with figure drawings of the same sex, and to project both consciously and unconsciously into these drawings some of their own characteristics.[3]

In our first series of tests, we obtained same-sex figure drawings from 45 patients, 26 among the mildly deformed (Group A), and 19 among the severely deformed (Group B). We found that the projection of the face in the drawings could be categorized in one of four ways: (1) those in which there was specific portrayal of the individual's disfigurement; (2) those in which there was distortion of the disfigurement (*e.g.* large nose in a drawing where the patient's disfigurement was absence of the nose); (3) those in which there was omission of all features of the face; and (4) the drawings in which the face had features that did

not seem disfigured in any way to the outside observer.

Among the 26 of Group A who produced drawings, there were four patients who specifically portrayed their disfigurement, and one who distorted it. Of the 19 subjects in Group B, five portrayed their disfigurement, five more distorted it, and one omitted all features of the face. Hence, according to the criteria described, in Group A there were 21 out of 26 patients who produced drawings without apparent projection of the actual or claimed disfigurement. In Group B (where the actual disfigurement was severe enough to be accepted as such by outside observers) there were only eight out of 19 patients who failed to project their disfigurement on the drawings.

A person may express in a figure drawing his needs and feelings, as well as the ways in which he deals with, and controls these needs and feelings. Drawings may reflect the body image which, according to Schilder, is experienced at the unconscious level, and can be projected onto drawings as it may into other material, such as fantasies and dreams.[4] Drawings may also reflect the individual's self-concepts and his preoccupations with facial disfigurement experienced both consciously and unconsciously. In the results we obtained from the 26 patients in Group A, it looks as though their expressed self-concept (verbal complaint about the face and request for plastic surgery) was not reflected so much in their same-sex figure drawings as was their body-image and/or their idealized self-concept. In these figure drawings, the patients had not been asked to draw a figure of themselves but rather to draw a person. Perhaps, if they had been asked to draw a figure of themselves, their self-concept of deformity would have been reflected in the drawings. (Some patients did make spontaneous comments about the drawings, saying how they could not get away from drawing themselves, but this was not so of the majority of patients.)

We can perhaps say this much, that the drawings of the mildly disfigured suggest the unrealistic nature of the actual disfigurement. These patients have distorted attitudes about their actual faces, but do not project this distortion into the drawings, projecting rather their correct body image at the unconscious level. The severely disfigured, on the other hand, reveal some aspect of disfigurement in same-sex figure drawing (by specific portrayal, distortion, or evasion), and thus they reflect either a correct body image of themselves or a preoccupation with the disfigurement about which they have verbally complained, but which is realistic and accepted as valid by the outside observer.

Within the limits of this investigation, we can conclude that about three-fourths of each group, A and B, make a same-sex figure drawing in which the features are dealt with in conformity with the actual condition of their own faces, the presence or absence of actual disfigurement. It is therefore suggested that the severely disfigured not only have a correct body image of themselves, as do the mildly disfigured, but that they may also regard their impairment as a more realistic handicap than do the mildly disfigured. It is as though the patients in Group B can successfully accept their disfigurement, and associate it with their emotional difficulties (even though these latter may not be related to their disfigurement), because others would accept and believe that their appearance would be a source of difficulty to them. This is not true of the mildly disfigured. The projection of the difficulty onto their face is less realistic, for their disfigurement is one that others can neither see nor easily believe. The figure drawings seem to bear out the correctness of this point of view which has been suggested by the Rorschach findings.

In other words, it would appear that the difficulties the facially disfigured report experiencing in interpersonal relationships and, in successful living, are reflected in the projective material. As we have said, however, the projective material reveals that the severely disfigured are somewhat less disturbed than are the mildly disfigured, that they have better control over their feelings and impulses, and that they accept themselves somewhat better. The mildly disfigured are less accepting of themselves. They also are more insistent that others should feel as they do about their actual or supposed deformity, but just why they use their face as the focal point for their difficulties, rather than projecting their problems onto other bodily areas (internal or external), is a matter for further investigation.

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DIVISION OF MYCOLOGY

STUDIES ON FUNGICIDAL ACTION USING RADIOACTIVE TRACERS*

By LAWRENCE P. MILLER AND S. E. A. McCALLAN†

In studying the mechanism of fungicidal action, it is important to know the actual amount of toxicant taken up by the fungus spores when exposed to the fungicide. It is also desirable to know the fate of the absorbed material, or whether it is also taken in and undergoes any changes within the host plant. Many of the fungicides are unstable, and readily yield other products when in contact with spores and other plant material, so that it is necessary to learn about the toxicity of those derived materials to understand the action of such fungicides. The availability of radioactive isotopes has made some of these studies much easier because of the great dilutions that can take place and still permit determinations of the quantities involved, and because the tagged element can be followed even after it has undergone chemical transformations.

This report covers work using both conventional chemical methods and radioactive tracers in studies on some of the interactions between sulfur, ferric dimethyldithiocarbamate, disodium ethylene bisdithiocarbamate, and 2-heptadecyl-2-imidazoline and fungus spores.[1,2] Included are quantitative studies of the conversion of sulfur to hydrogen sulfide, and the release of carbon disulfide from the dithiocarbamates, and the comparative toxicity of the various products. The amounts of toxicant required per fungus spore to prevent germination has been determined for sulfur and for the imidazoline, and have been found to be comparatively high. The actual dosage is many times higher than the concentration of the applied solution or suspension.

Eight species of fungi were used in these studies: *Sclerotinia fructicola*, which is sulfur sensitive; *Glomerella cingulata*, which is moderately sensitive; and *Neurospora sitophila*, *Neurospora crassa*, *Alternaria, oleracea*, *Cephalosporium acremonium*, *Rhizopus nigricans*, *Aspergillus niger*, and *Stemphylium sarcinaeforme*, which show varying degrees of sulfur resistance. Dry baker's yeast in pellet form was also used in certain tests. The spores varied widely in size from .0064 mg. per 1,000,000 spores of *Cephalosporium acremonium* to 9.3 mg. for *Stemphylium sarcinaeforme*.

In former work by McCallan and Wilcoxon,[3] extensive studies were carried out on the reduction of sulfur to hydrogen sulfide by fungus spores and other plant tissue. Since the hydrogen sulfide was toxic to the spores, it was believed that sulfur exerted its fungicidal action by virtue of being reduced by the spores to toxic hydrogen sulfide. The toxicity of hydrogen sulfide in these studies was determined by allowing hydrogen sulfide to come into solution in the aqueous drop containing the spores from a reservoir of hydrogen sulfide vapor above, in accordance with Henry's Law. This method was used to offset the disadvantages of testing open solutions of hydrogen sulfide in water, in which the hydrogen sulfide had been reported relatively nontoxic by earlier workers. This was due to loss of hydrogen sulfide by diffusion and oxidation. In the current studies, dilutions of hydrogen sulfide in water were placed in small stoppered vials containing the fungus spores. The vials were completely filled, so that there was no air space above. After 24 hours, the spores were removed and placed in a suitable environment for germination. Hydrogen sulfide was also obtained from silicon sulfide placed in vials containing the spores. The silicon sulfide slowly hydrolyzed to liberate hydrogen sulfide. The toxicity to fungus spores by both methods was similar. For comparison, the toxicity was likewise determined for a wettable sulfur, and also for a colloidal sulfur specially prepared for these tests. The wettable sulfur was toxic only to *Sclerotinia fructicola*. The ED50 values (or concentrations in p.p.m. of the external toxicant which permitted 50 per cent of the spores to germinate) ranged from 2.8 for *Sclerotinia fructicola*

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to 88 for *Stemphylium sarcinaeforme*. Similar values for the colloidal sulfur ranged from 0.5 to 31, and in five of the fungi the colloidal sulfur was significantly more toxic than the hydrogen sulfide. In the other three fungi, there was no significant difference. Hence, the role of hydrogen sulfide in the toxicity of sulfur is probably less than previously supposed. The marked effect of the physical form of the sulfur on toxicity is also to be noted.

When spores were exposed to elemental sulfur in finely divided form, absorption of the sulfur, and release of hydrogen sulfide were very rapid with a number of species studied. If the sulfur available is not excessive, but limiting, the spores will give off (as hydrogen sulfide) practically all the sulfur present. Investigations with spores of the nine species of fungi have shown that some of these will absorb sulfur at the rate of about one-half of one per cent of their fresh weight per hour for the first few hours of exposure. With the spores reasonably sensitive to sulfur, about one-half per cent of their fresh weight, or 5000 p.p.m., had to be taken in before the spores were unable to germinate. Some species can absorb much more than this amount without being killed. Thus, absorption of large quantities could take place, with concomitant production within the spore of large quantities of hydrogen sulfide, without the prevention of germination. A few species, such as *Aspergillus niger* and *Stemphylium sarcinaeforme*, absorbed much less sulfur and were also, therefore, not sensitive to the fungicidal action of sulfur. Thus, some species were killed after having given off about the equivalent of 5000 p.p.m. of their fresh weight as hydrogen sulfide, while others could give off even more, up to about 50,000 p.p.m., without the germination being completely inhibited, while some absorbed very little sulfur, and were, therefore, little affected.

The great affinity of spores for sulfur has also been demonstrated by the use of radioautographs of leaves infected with powdery mildew and exposed to the vapor of radioactive sulfur. The mycelium will take up much more sulfur than the adjoining host tissue. Similarly, exposed spores take up much more sulfur than a variety of control materials investigated.

The dithiocarbamate fungicides, ferric dimethyldithiocarbamate (ferbam), zinc dimethyldithiocarbamate (ziram), disodium ethylene bisdithiocarbamate (nabam), zinc ethylene bisdithiocarbamate (zineb), and tetramethylthiuramdisulfide (thiram), in the presence of water, all liberate small amounts of carbon disulfide at the approximate rate of 0.2 mg. per 100 mg. of fungicide in 24 hours. In the presence of fungus spores or yeast, the carbon disulfide liberated is increased many fold. Only nabam released hydrogen sulfide, and only to the extent of .01 mg. per 100 mg. in 24 hours. This was increased tenfold in the presence of yeast. A comparative test was made of the toxicity of ferbam and its basic components dimethylamine and carbon disulfide, and of nabam and its components ethylene diamine and carbon disulfide. In most cases, dimethylamine was less toxic than ferbam and ethylene diamine was likewise less toxic than nabam. Carbon disulfide was also less toxic, and is not believed to be a primary toxic agent in the decomposition products of nabam or ferbam.

The tendency for spores to accumulate materials used as fungicides was also evident in studies with ferric dimethyldithiocarbamate, and especially so with 2-heptadecyl-2-imidazoline. The latter, available with a C^{14} label in the ring, has been found to be taken up extremely rapidly by most of the spores tested. When used at 2 p.p.m., a concentration approximately the ED50 value for the spores of some species, about 90 per cent of the available imidazoline may be taken out of solution in one minute or less. This rate of removal is only lessened appreciably when the quantity of spores present is so small that concentrations of over 10,000 p.p.m. of spore weight would be reached. The dosage received by the spores is thus determined by the ratio of total weight of chemical to total weight of spores present and, if this ratio is varied, the dosage is quite unrelated to the concentration of the solution used. A whole dosage-response curve may be constructed using only one concentration of chemical, and varying the quantity of spores used. It would thus appear that probably many of the so-called dosage-response curves that have been obtained, and in which the external concentration of the toxicant has been designated as the dosage, are in error as far as true dosage is concerned. Also, when spores of widely differing weight are used in a test, the dosage received by the smaller spores may be much higher than by the larger spores unless proper adjustments are made.

Actual dosage received by the spores is important in any attempt to study the effect of changes in chemical structure on true toxicity.

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SECTION OF ANTHROPOLOGY

CHINESE SOCIETY: CLASS AS SUBCULTURE*

By MORTON H. FRIED†

The question continues to arise as to the contributions to the study of complex societies which may be made by anthropology as a discipline. This problem has troubled most anthropologists but none have been more greatly concerned than the specialists in the Far East. At a recent meeting of such specialists, for example, it was suggested that "the field of the cultural anthropologist in China largely falls into aspects neglected by the disciplines traditionally engaged in Chinese studies."[1] Specifically, it was felt that anthropologists might contribute most by studying regional variations in Chinese culture, while the tendency for "those interested in Chinese civilization as a whole [to] overlook the less spectacular and at the same time more basic aspects of Chinese life, that is, the life of the masses in town and countryside" was deplored. The present paper will indicate how the traditional picture of Chinese society may alter when complemented by more extensive knowledge of the culture of Chinese peasants and workers.

That the cultural norms of one class in Chinese society do not necessarily apply to other social groups in that society has long been understood by some of the most prominent workers in the Chinese field. Fei Hsiao-tung, for example, has elaborated on the dichotomy in Chinese society between peasantry and gentry: "When the historians exalt or condemn the Greeks or the Romans, they have in mind only the warriors and the philosophers. Is it not true that China has been praised and criticized according to that China which is found in Western museums, exhibited in art galleries, and described by writers of best-sellers? The China so represented comprises only the minority, the leisured gentry. A fair view of China, however, should include both the poor and the rich and the relation between them."[2]

Even before Fei was studying Chinese peasant communities, an American sinologist remarked in an analysis of the state cult of Confucius that "Confucius was the patron, not of the Chinese as a whole, but of a sharply marked class in Chinese society."[3] Yet, in the same year, a Chinese social scientist gave further support to the common assumption that "Confucius has been the national ideal of the Chinese people, and the [Confucian] Classics have been a mirror in which has been reflected the national mind of China."[4]

The simplistic view of society which underlies such broad pronouncements, particularly in the realm of so-called national-character studies, has drawn increasing critical attention. Thus, such studies have been criticized because in them "National culture is represented as if it were homogeneous, as if the same factors affected personality in all regional, ethnic, racial, occupational, class, professional and other segments of society."[5] But the societies which sometimes are seen to produce uniformities of individual behavior and remarkably well integrated value-systems are far from homogeneity. "A contemporary society is not integrated through uniformities of individual behavior. It is an extremely heterogeneous entity whose total 'pattern' consists of intricately interrelated parts of different kinds . . . No individuals or groups of individuals carry an entire national pattern.

* This paper was presented at the meeting of the Section on May 26, 1952.
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They participate only in very special portions of the entire culture."[6]

The concept of culture, probably the most significant contribution yet made by anthropology to social science, furnishes a tool whereby the patterned but dissimilar lifeways, which are found in complex societies, can be united in a single conceptual framework.[7] But the anthropological concept of culture is not yet universally applied, and some social scientists continue to use the term "culture" to refer to specific achievements of a part of a society, accomplishments which are ranked high in the observer's scale of values. Nowhere is this more common than in the study of Chinese culture where a belief persists that the cultural achievements of China are summed up in the life and traditions of the scholar-gentry.[8, 9] This idea results in an odd dilemma for its adherents, who must claim a virtual monopoly of the culture for the scholar-gentry, particularly in terms of participation, innovation, and transmission, while at the same time seeing the peasantry as also bound by the same goals and values. Furthermore, if this concept is rigidly held, many contemporary traits and events will prove exceptionally mysterious in their origins. Whence would one derive, merely by way of example, the emphasis now placed on the *yang-ko*, a peasant dance, or the renaissance of graphic arts stressing not caligraphically inspired painting but virile woodcuts and violently colored lithographs; or, in another aspect of the culture, how is one to account for new developments in the structure and functioning of the family and extended kin units?

By way of a preliminary entrance into this problem, a small study of the status of the military in Chinese society was undertaken.[10] Briefly stated, the usual picture indicates that military men are universally despised in China, that militarism is abhorred, and that the Chinese have traditionally exalted pacifism. Such generalizations conflict with the evidence of recent Chinese developments and, furthermore, lack confirmation in history. When a more thorough investigation is made, antimilitarism is still seen to have existed in China, but not to have been common to all sectors of the population. The scholar-officials have been identified most frequently and consistently with antimilitarism, though not at all times, and not always to the same degree, while the mass of the population, largely unaccounted for in the literary record, have demonstrated themselves to the contrary in their behavior and in their projective systems.

The question of the Chinese view of militarism and military status, however, is merely one aspect of a larger problem. When a complex society is to be described, what point of vantage, what orientation shall be used? When this problem occurs in the analysis of our own society, it is often resolved by a broad "middle-class" view. In China, where no analogous social group could be found, the Western writers found a prefabricated model ready for adoption. This was the view of Chinese society which had been held for countless generations by the scholar-gentry, a group which, if it did not control Chinese history, at least exercized considerable power in its recording.

The view that Chinese-gentry culture is, in an ultimate sense, Chinese culture has been advanced by a large number of influential Chinese spokesmen, including philosophers, political scientists, historians, economists, sociologists, and anthropologists. In most cases in which the writer was a social scientist, the view was presented as if it was a conclusion based on research, but one searches in vain for supporting data. What does emerge, however, is the distinct impression that the view of the cultural potency of the literati is a central and necessary theme in the *eidos* of the scholar-gentry, and an especially valuable one because it specifies the role of the intelligentsia in the total society. Chinese social scientists, who have marvelled at the failure of the Chinese literati ever to compose an independent political party, have failed to take this into account.[8, 9, 11] The belief in the widespread potency of literati culture is a sociological fact but a tricky one. It is factual in its existence as a value and an ideological assumption of a specific social class, but it is not a fact that the assumption operates, as the literati would like us to believe, beyond the confines of their own class.

The ideological assumptions of the literati, however, have played a significant part in the course of Chinese history. Internally, they have served to reinforce a certain political organization formed originally under the impact of certain geographic, technological, and economic demands. Externally, since the transmission of these values almost intact to the West has made the Western view of Chinese society a reflection of the gentry

view, these assumptions have played an important role in shaping 150 years of social, political, and economic interaction between China and the West.

Even today, one frequently encounters the assumption that Chinese gentry culture is the heart of all Chinese culture. The failure of American foreign policy to recognize the indigenous forces in the present Chinese revolution furnishes an excellent example of the persistence of the view of China in terms of gentry values. Meanwhile, less obvious problems of a subcultural nature perturb the Chinese communist government.

The new Chinese political structure, by its own slogan, is a worker's and peasant's state. The actual socio-economic composition of China, however, defies simple description. So many errors followed when the agrarian reform laws were actually put into practice, that a supplementary document was published, entitled "Decisions Concerning the Differentiation of Class Status in the Countryside," a document which explores, albeit briefly, the nature of the various rural classes. Though not holoistic in approach, failing to treat fully of the phenomena, it is definitely cultural. For example, a description is given of a "well-to-do middle peasant" family. "The family's land is entirely cultivated by its own members. The family has five rooms, an ox, and also a pond . . ." We learn further that the family raises pigs and lends out grain.[12] But, most interesting in this document is the arbitrary denial of the discrete class status of intellectuals in the face of customary identification to the contrary. The document says, "The intellectuals should not be considered as a class. The class origin of intellectuals is to be determined according to the status of their families. The class status of the intellectuals themselves is to be determined in accordance with the means they employ to earn the major part of their income."[12] Though the document thus attempts to repudiate the class status of the intellectuals, it gives tacit recognition to their historical class position by calling for the education of the literati "to overcome their erroneous ideas of looking down upon the labouring people." At the same time, one is informed of the resentment of the people in some localities to the intellectuals, and there is a demand for the legal protection of the "brain workers."

If the gentry view of Chinese society has had certain effects during the course of Chinese history, it is by no means certain that those effects are banished into the past. There is a strong possibility that certain conditions which previously were associated with the literati view of Chinese society may survive in the present regime. Should they do so, it would be logical to expect a recrudescence of the old gentry value system. There can be no denial, for example, that large numbers of present bureaucrats are recruited from the older ranks of officeholders. Furthermore, there is at least one reported instance of a reversion in patterns of land tenure in a district of Shansi which, having already undergone land redistribution, is in the throes of a new trend toward reconcentration of the land.[13]

What is the nature of Chinese class-subcultural variation, and what, in particular, is the nature of literati subculture? To begin the analysis, it is necessary to recognize two different categories of factors, the actual modes of behavior, and the values associated with the specific patterns of living. To set up such a dichotomy may seem a regressive, antifunctional step but, as has already been indicated, the task of separating the gentry view of the world from the actual order of things is of first-rate importance. In dealing with specific traits or institutions, many scholars have been quick to point out that literati standards are not universal as concrete and operating ways of life. The same people, however, often assert that the values involved, in this case the desire to achieve the literati way, are universal. An outstanding example may be drawn from the realm of Chinese familial organization. It was believed for a long time that the typical Chinese family was a populous unit and that the clan was a common feature of Chinese social organization. Research produced some markedly contrary data. As a result, articles began to appear bearing such titles as "The Myth of Chinese Family Size,"[14] but the writers of such articles, though showing the inapplicability of the old *a priori* evaluations of Chinese society to classes other than the literati, did not seek to extend their findings to the point of contradicting the potent assumption that Chinese society was based upon a universal devotion to the value system of the gentry.

For this failure, it must be admitted, there was some good reason. Innumerable, if unsystematic, observations of Chinese families, which were in the process of moving upward through the socio-

economic hierarchy, indicated that familial patterns altered almost directly with the degree of progress that was achieved. This is sometimes taken as *prima facie* evidence of the universality of literati values, a conclusion which does not necessarily follow from the data. The argument is somewhat as follows: Since families conform to literati standards as soon as they are able, it may be assumed that they always wished to do so. Failure to do so is the result of fortuitous personal circumstances, largely of an economic nature.

The basis of this ascription of universality to upper-class values is a platonic concept of reality which, seeing the wish as parent of the deed, interprets society in terms of the verbal images which are produced by a specific segment of the society, generally the dominant class. Such reasoning, while a source of great satisfaction to those who identify with the ruling ethic, is of value only as long as no profound changes occur in the organization of the society. When the predominant mode of social mobility is an individual or even a familial one, the platonic equation is operative and may serve as a tool and a gauge for the social scientist. But, with such a tool, one gets at best only a static view of a dynamic entity. In situations of revolutionary change, especially when whole classes forge ahead as groups, perhaps to displace former ruling groups, the tool becomes completely useless.

To be more specific, it is necessary to reiterate a basic point, which is frequently lost sight of by students who concern themselves with complex social phenomena. Social mobility, far from negating the existence of classes in a society, is a requirement of a class structured society.[15] Single individuals, or families which move through the social hierarchy, must utilize the existing norms of behavior as their milestones of progress. It is not remarkable that they should do so, it is unthinkable that they should not. But, when a whole class alters its position in the society, it is in a position to bring forward substantial segments of its former subculture, including innumerable elements which would have been too gross to pass through the fine selective screen of individual mobility.

If the platonic view were a correct one, we should expect a more-or-less rapid florescence of the former upper class modes of behavior in newly located groups—a process which would continue until the new group became a fair duplicate of its predecessor. Once again an idealistic conception would strip from the social scientist his ability to detect the sources of locomotion in culture. Culture change, like motion in Zeno's paradox, would be anomalous.

The persistence of certain traits, patterns, and even whole segments of the former upper-class culture, and the alteration of former lower-class culture, two sets of factors which form the major justification of the idealistic view, are not to be denied. At the same time, they must not be overstressed. Like the mountain peaks of a sunken continent, the survivals help shape the new landscape but they are no longer its dominant feature.

Returning to the analysis of Chinese society, we note that a comparison of the two great classes, the peasantry and the gentry, substantiates the designation of the classes as subcultural entities. But, what also becomes clear when a comparison is attempted, is the frequent inadequacy of the material on peasant culture, especially in its historical aspects. In the following brief comparison, the basic categories are adapted from the listing of cultural universals developed almost three decades ago by Clark Wissler.[16]

Speech. The aspects of Chinese language which have attracted the linguists are historical and regional. Studies of argots and lower-class speech patterns would probably reveal sharp differences between gentry and peasant speakers of a single dialect. Of much greater significance, however, is the control of writing. It is precisely through the medium of this control that the gentry values have been generalized into national values. The problem of the exclusive nature of the Chinese written language has been recognized for several decades. The earliest proposals for reform concentrated on a use of colloquial forms in writing rather than the exceptionally difficult *wen-hua* or classical style. There was also an early move for a "basic Chinese," with a minimum of important characters to be taught to a maximum number of illiterates. Also started in the pre-Communist period, but presently reaching new levels of application, is the drive to replace the characters with an alphabetic system for purposes of normal written communication. All of these attempts reflect the importance of the cultural variations which accompany class distinctions.

Material traits. Wissler lists six sub-categories, food habits, shelter, transportation and travel, dress, utensils and tools, weapons, occupations and industries, of which only the penultimate does not pertain to our present purpose. It is not possible here to go into detail on each category, but it should be noted that the differences which appear are not simply those of quality (*e.g.*, the peasant has a knife but the gentleman has a better one), but are differences in whole traits or whole complexes. Thus, in diet, rice as the upper-class staple grain gives way to maize in the less privileged classes while the meat, fish, and fowl of the gentry table become bean derivatives in the peasant's bowl. That the peasant who might achieve sudden wealth would as quickly alter his diet and assume the tastes of the gentry is actually an untested conceit, not as strong perhaps, as the frequent assumption among middle-class Americans that steak with trimmings is the ultimate desire of the world's population, but quite similar in its application. As a matter of fact, the peasant who achieves wealth is not too likely to adopt many material traits of the gentry. His house will often remain humble, and his clothing quite poor in order to avoid attracting the unfavorable attention of the tax-collector or the bandit. What is most likely to change, however, is his attitude toward personal labor. He would become a drone, for as a Chinese anthropologist remarks, "The Chinese describe labor as 'sweat and blood.' . . . The people who work on the farms, being made of flesh and blood, would be difficult to convince that greater happiness would be achieved by more work. The avoidance of painful experiences, which are necessarily involved in work, is their immediate concern."[17] It should be noted that it is also the experience of the Chinese peasant that "land breeds no land," and that manual labor produces subsistence but very rarely wealth.

Art. There is a significant lack of treatises on the subject of Chinese folk art, whether relating to the graphic arts, or to music and poetry. In the absence of a thorough study and comprehension of peasant art, it is not surprising that the colloquialization of art, which accompanied the "New Life Movement," should frequently be derived from Western stimuli. To criticize this view is a matter for competent specialists. Yet, one who has some experience of the Chinese peasant culture, must wonder at the historic depth of an artistic expression that bears few resemblances to the productions of the intelligentsia. The graphic art of the literati has its major source in calligraphy. Stressing the beauties of nature, it underplays man and achieves its effects with subdued colors and exquisite modulations of subtle tones. Peasant art, on the contrary, is more interested in person and symbol, approaches the supernatural directly and without selfconsciousness, and stresses violent and unmodulated color. Surely, the traditional values of peasant art are to be found close to the root of the present developments in Chinese "national" art.

Religious practice. The description of peasant religious values and behavior has had more attention than most other aspects of peasant life, excepting agriculture. Much of this work has been accomplished by missionaries, an implicit recognition of the necessity of dealing with subcultural entities. The terms "Taoist," "Buddhist," "Confucianist," and "ancestor-worshipper" are difficult enough to apply to the gentry; when they are applied to the peasantry a completely false and chaotic picture can result. The Chinese peasant differs from the gentleman in his concern with a supernatural which consists largely of nature spirits. The importance of the ancestral cult is related to the importance of extended families and clans. Since the extension of the family unit is not a normal phenomenon among the peasantry, it may be possible to conclude that ancestor worship appears among the peasants only in an attenuated form, or not at all.

Family and social systems. As was stated above, the forms of familial and kin organization, which furnish such an important element in the usual Western conception of China, do not pertain to the peasantry at large. Clan organization involving masses of peasants is now asserted only for southeastern China. Recent studies show that in most of China the predominant familial unit among the peasants and among the urban lower classes tends to be nuclear, consisting of parents and children, while clans and extended families prevail among the gentry. Even the marital patterns of peasants and the gentry show great dissimilarity. Fei points out that the motives involved in marriage and the criteria affecting the choice of a spouse differ markedly, the gentry seeking good political and economic

ties, while the peasants hope for a strong and capable worker. Equally marked in the past have been the divergent views on divorce, the gentry preferring the widow to remain unmarried and serving the deceased husband's parents, while the peasants not only sanction a remarriage but urge it as an economic necessity.

Space does not permit a fuller elaboration of the theme, but the essential thesis is now clear. Chinese society is too frequently interpreted in terms of gentry patterns and ideals. The lower class cultures of China have been neglected. When interpretations of contemporary Chinese events or traits are attempted within the framework of the Chinese gentry interpretation of Chinese society, conclusive explanations fail to materialize, and frequently the analyst must overstress the role of diffusions from the West. When the gentry view is supplemented with a more complete understanding of Chinese peasant culture, it may be seen more clearly that the present culture of China is the result of deep indigenous forces which have been catalyzed by developments of a worldwide nature.

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SECTION OF OCEANOGRAPHY AND METEOROLOGY

APPLIED CLIMATOLOGY*

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Climatology is, at the present time, a rather neglected field. In the teaching of climatology, the statistical representation of data is often overemphasized and, in some cases, the discussion of climatic problems is more or less restricted to certain basic chapters of meteorology (radiation, hydrologic cycle, *etc.*). Applied climatology is hardly mentioned. Only since the translation of R. Geiger's book, "The Climate Near the Ground," was published (Harvard Univ. Press, 1950), certain phases of applied climatology are dealt with more frequently to some extent. Four of these phases are listed below.

The ever-increasing industrialization of the United States creates serious problems of pollution in large cities and their surroundings, and sanitation engineers, charged with the tremendous task of air purification, study the problems of the "dust roofs" from the standpoint of chemistry, stability, turbulence, self-purification, and the like. Since the active surface in cities consists of asphalt, concrete, bricks, and similar materials, special microclimatic problems exist, which are very different from those encountered over natural soil and vegetation.

America is becoming conservation-conscious, and the preservation of our forests and reforestation problems are now matters of nation-wide interest. Forest management profits highly from a detailed knowledge of the peculiarities of canopy interferences, wind-breaking effects, the microclimate within the trunk space, the particular features of the climate of rejuvenation glades of different sizes, *etc.* The problems of American forests are not entirely identical with those encountered in Europe, because of the differences in the macroclimates of the two continents, and of the fact that layered canopies are much more frequent in this country than in Europe, where

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uniform canopies prevail in many stands which have been cultivated for centuries. Reforestation is of greatest significance for snow preservation, and thus for irrigation purposes in the West, since wind speed is the most significant single factor in snow losses by evaporation.

Shelterbelts are of vital importance in the interior of the continent, since North America displays the unique feature of having its highest average wind speeds in its innermost parts. Shelterbelts provide not only protection against mechanical injury to crops, but are genuine preservers of soil moisture, due to a reduction of evapotranspiration and to a reduction of snow evaporation. Since all microclimatic features are modified within the sheltered area, it is important to study the effects of composition, height, length, density, and shape of the belts. These problems are of interest not only to the agronomist, but also to the rancher, interested in the protection of livestock during blizzards, to the highway engineer, interested in snow blowing, and to the architect, who is concerned with the relations between wind speed and fuel consumption.

Problems of frost protection are of particular interest in America, with its frequent meridional surface-circulation patterns, and its great frequency of advective cold waves, which are not blocked by high west–east running mountains, as is the case in Europe and in parts of Asia.

A detailed discussion of these problems would not be without interest but, since abundant, although scattered, literature is readily available, the main topic of this lecture is to be devoted to certain studies carried out at the Department of Meteorology of Rutgers University, the State University of New Jersey (E. R. Biel, A. V. Havens, & J. E. Carson).

It seems appropriate to stress in the very beginning the fact that reduction of all nonsimultaneous data to standard periods is an absolute necessity under East American conditions, regardless of the meteorological element under consideration, or of the type of statistical representation (medians, frequency distributions, *etc.*). The simple methods of the reduction procedures, as developed generations ago by Lamont, Mahlmann, and others (semi-constant differences or ratios between base stations and stations with short records), are still frequently ignored, with the result that closed systems of isolines appear on maps, indicating nonexisting "islands" of higher or lower values, of greater or lesser frequency, *etc.* These are the result of a confusion of the time factor with the space factor. The necessity of reductions to standard periods increases with the variability of a given climate, and reaches its maximum in "dependent climates" in the sense of V. Conrad's definition (climates primarily controlled by advective processes). East American and East Asian are model cases of dependent climates—nonsimultaneous data are not comparable under such conditions and must be made comparable. If conscientious reduction procedures are ignored, serious errors are bound to result, particularly in the discussion of the agroclimates of smaller regions (counties, *etc.*). It is helpful to employ those checks to the validity of the reduction procedures that were recommended by V. Conrad: The deviations of the semi-constant differences or ratios must be checked against the deviations of the elements themselves. These precise checks are preferable to the vague topographic and orographic older rules of permissible horizontal and vertical distances. Their application leads occasionally to the discovery of significant climatic discontinuities.

One study carried out at Rutgers deals with the length of the growing season in New Jersey, and the occurrence of frosts within this period. The common definition of the growing season, as the average duration of the frostless period, has often been severely criticized, and justly so, by H. Landsberg and others: The "killing frost" data do not refer to standard test plants, which are killed or injured by frosts of certain intensities, nor do they refer to minimum temperatures measured within the micro-layer. In most cases, they simply indicate that the minimum screen temperature reached the freezing point. R. Geiger and others have shown that such data are not representative at all as far as effects on vegetation are concerned. The definition frequently used by agronomists and ecologists ("vegetative growing season"), which is based upon the "zero of vital temperature" (about 43° F. for many common plants), is much more useful. Naturally, "individual zeroes" (average temperatures at the average time of planting) have to be used in studies on individual species. A set of maps was completed for the State of New Jersey showing the beginning, duration, and end of the vegetative growing season. The period in spring, after the start of the vegetative growing season

and before the start of the frostless season, is of particular interest to the farmer. This period of anxiety is rather short along the immediate coast (two weeks), increases to four weeks in Central New Jersey, and to six weeks in the inversion basins of the northern hills. Similar conditions prevail in autumn after the end of the frostless season, and previous to the end of the vegetative growing season. The frequency of frosts during these biologically significant periods was studied, and the results indicate clearly that frosts never failed to occur during those periods, reaching amazing frequency values in years with very late spring or very early autumn frosts. Thus, frost-chance tables were calculated in a manner similar to those offered by Thom and Shaw for Iowa. The chance of occurrence of frosts after the median date of the "last killing frost" is still fifty per cent. If this risk seems too high, it can be reduced to any desired percentage by the use of the frost-chance tables. Numerical values were offered for New Jersey spring and autumn conditions. Shaw has also studied the frequency of frosts of certain intensities and similar studies are now under way for New Jersey.

The question of the frequency of genetic frost types is of great practical importance. Radiation frosts, associated with sharp inversions and very low wind speed, are mostly spotty, and protection is promising; while wide-spread advective frosts offer much more serious problems. Heaters work only with inversions (if the small effect of direct radiation is neglected), and their effect is the more pronounced the sharper the inversion, or, in other words, the lower the level at which the heated air stops rising. Ventilators and helicopters naturally work only with inversions. In California, ninety per cent of all frosts are of the radiation, and only ten per cent of the advective type. C. Janifer showed recently by an analysis of three years of Central New Jersey data that approximately one-third of the frosts, occurring during the spring period of anxiety, is advective in nature. Thus, the New Jersey farmer has to familiarize himself with the properties of genetic frost types, with the relative merits of frost protective measures and particularly with the physical basis of protection by infrared radiation. To those interested in frost protection by covers, the excellent studies on the respective merits of umbrella-shaped *vs.* cone-shaped cover types by W. Schmidt are of great value.

The variability of the amounts of the annual and growing season precipitation was studied. The dependability of the annual amounts is greatest in the tropics proper (reliable convective rains) and in the latitudes of the circumpolar vortex, where travelling disturbances along the "polar front" or under the jet streams control the climate. The greatest fluctuations occur in the subtropics and at the polar caps. New Jersey compares very favorably with most of the rest of the United States and of the globe as far as the reliability of its annual precipitation amounts is concerned. The same holds true with respect to the standard deviation of the rainfall occurring during the vegetative growing season. Since, however, agronomists are more interested in precipitation frequency than in amounts (the growing-season precipitation, in spite of prolonged droughts, may be high, due to cloud bursts and hurricane tail ends in autumn), the reliability of the frequency of rain during the vegetative growing season was likewise calculated. The results indicate that in New Jersey the number of rainy days during the growing season is likewise rather dependable in comparison with other regions. W. C. Thornthwaite's excellent studies on New Jersey soil-moisture conditions are, of course, indispensable in any discussion of agricultural problems. Figures on raininess (amount of rain per rainy day) are significant with respect to soil erosion, to the washing-out of fertilizers and so on. It is, therefore, regrettable that hardly any maps on raininess seem to exist. J. Caprio used, in a study on dry spells, the conception of the "drought index," as introduced by W. Schmidt, the index being based on weighted values depending on the length of the drought. This index was used to determine the mean maxima of consecutive rainless days which a New Jersey farmer has to be ready to face month after month.

J. Cantlon of the Botany Department of Rutgers University completed a study on exposure microclimate, based on measurements at different levels above ground on the northern and southern side of a hill in Northern New Jersey (Cushetunk Mountain, altitude seven hundred feet), the stations being close to the summit. While the general differences in exposure microclimate, with respect to soil temperature, soil moisture, wind speed, forest fire danger, growth rate, *etc.*, are well known; it was unknown,

previous to Cantlon's study, to what extent these differences increase from the canopy to the moss level. The degree of vegetative differences as defined by the ecologists more than doubles from the tree to the bryophytic level.

The dusting of forests and crops from airplanes against insect pests is becoming a common practice. R. Geiger has shown that wind speed and turbulence, during the very short period between the release of the minute particles from low-flying airplanes and their arrival at the canopy level or at the ground, are very significant factors for the success or failure of the dusting operations. On fair days, dusting is most successful during the hour after sunrise or during the period before sunset. The morning hours are preferable, due to lesser turbulence and higher relative humidity which is associated with higher adhesivity of the particles. Under East American conditions, the probability of rain falling during the hours after the dusting operation, which would knock off the particles, is much less with morning than with evening dusting, since intense rains from convective clouds are primarily a phenomenon of the later afternoon and early evening hours. Forest dusting from airplanes is preferable to dusting from the ground, due to a variety of reasons discussed by R. Geiger in a little-known paper (inversion lid at the canopy level, *etc.*).

The interdiurnal variability of temperature is a significant indicator of the dynamic structure of a climate, and has also widely been used as an indicator of climatic health values. New Jersey's values are extremely high. There are naturally regions with greater thermal fluctuations between successive days, but most of the centers of high values of the isometabolic lines are located deep in the interior of continents in the neighborhood of the continental "poles of cold," and not in the immediate vicinity of an ocean. These variations, due to frequent air-mass changes or, to rapid modifications within air masses, represent not only a great strain on human health and on plants, but are also a stress on building materials. The rapid weathering of the hieroglyphics of New York's Egyptian obelisk offers a good example. When the obelisk was brought to New York in 1879, the 34-century-old inscriptions were well preserved, but they have suffered very severely, after only three-quarters of one century, from the heavy rains and drastic air-mass changes that characterize our climate. The calculation of the interdiurnal variability of equivalent temperatures would, by the inclusion of moisture, cover the combined effects of temperature and humidity.

The continentality of the climate of New Jersey was studied by the use of F. von Kerner's "thermoisodromic quotients." This quantity seems preferable to other terms indicating the rate of continentality, since it covers both thermal lags and thermal ranges. The difference between the average October and average April temperature is divided by the annual range and multiplied by 100. Due to the slow warming and cooling of water, maritime stations experience warm autumns and cool springs, and display very high thermoisodromic quotients. Continental stations are mostly only slightly warmer in fall than in spring, and the quotients are low—there are even cases of zero and of negative values. According to C. Janifer, New Jersey records only along a narrow strip on the immediate coast moderately high values, while the climate is continental a few miles inland. These quotients are a rather striking expression of the dynamic processes which control the dependent climate of the State. The calculation of "relative temperatures," as defined by W. Köppen, yields similar results.

One of the most neglected chapters in American climatology is the study of the health values of its climates. It seems almost that the interest in medical climatology was greater a century ago than today. The Surgeon General of the United States Army supervised from 1818–1890 a network of well-organized stations, and one of the earliest books on the climates of this country was written in 1842 by Dr. S. Forry, who based his findings "on endemic influences" on the observations of these medico-climatic stations. It would be highly desirable to apply the methods of medico-climatic research, developed in Switzerland, Austria, and Germany, to American conditions, and to study the combinations of climatic specifications for different types of health resorts (coasts, mountains, semi-deserts, winter sports, convalescence, old age, *etc.*).

A variety of other problems of applied climatology of interest to agronomists (combination of phenological, meteorological, and astronomical data; snow ridging techniques), to foresters (forest spot fires and upper return currents above surface sea breezes), and to architects (shock rains, thunderstorms, and snow under New Jersey conditions) was briefly discussed.

In the opinion of the author, climatology is basically the physical geography of the atmosphere. The climatologist describes as a first step the facts and represents them by a variety of statistical methods. Purely descriptive and statistical climatography, however, is elementary and unimpressive. The climatologist needs the results of meteorological research in order to explain the phenomena described. He also needs some knowledge of agronomy, ecology, and other sciences in order to apply his findings to a great variety of human activities. Comparative climatology, the study of the modifications of given phenomena under different combinations of physical and geographical factors on a global scale, is a very promising, but rather neglected field. Those meteorologists who refuse to see how much studies in comparative and applied climatology have to offer are rather shortsighted. One of the main purposes of this address to a group of distinguished colleagues was to strengthen the tie of common interests that should connect both meteorologists and climatologists.

NEW MEMBERS

Elected May 15, 1952

SUSTAINING MEMBERSHIP

DePalma, Anthony F., M.D., Orthopedics. Prof. of Orthopedic Surgery, Jefferson Med. Coll., Philadelphia, Pa.

Rosenberg, Paul, B.A., M.A., Physics. President, Paul Rosenberg Associates, Mt. Vernon, N. Y.

Silverstein, Martin Elliot, M.D., Surgical Physiology. Chief Resident Surgeon, N. Y. Medical Coll., New York, N. Y.

Windle, William F., Sc.D., Ph.D., Anatomy, Physiology. Scientific Director, Baxter Labs., Inc., Morton Grove, Ill.

ACTIVE MEMBERSHIP

Al Akl, Fouad M., M.D., General Surgery. Assoc. Attend. Surgeon, Kings County Hosp., Brooklyn, N. Y.

Aldendorff, Herbert, M.D., Psychoanalysis, Psychology. Private Practice, New York, N. Y.

Altschuller, Gregory, M.D., Biology, Psychology. Private Practice, New York, N. Y.

Amill, Luis A., M.D., Internal Medicine, Hematology. Attending Physician, Director of Blood Bank, and Chief, Hematology, St. Luke's Hosp., New York, N. Y.

Beyers, Milton R., M.D., Internal Medicine. Private Practice, Huntington, N. Y.

Boerner, Herman F., Jr., M.D., Psychiatry. Private Practice, Philadelphia, Pa.

Bunce, Donald F. M., II, Neurology. Instructor in Anatomy & Neuroanatomy, St. Louis Univ., Mo.

Carlson, Harvey C., M.S., B.S., Microbiology. Research Technician, Univ. of Mich., Ann Arbor, Mich.

Castanedo, Carlos A., M.D., Medicine, Dermatology. Instructor in Dermatology, Univ. of Havana, Cuba.

Cheng, Kuang Lu, Ph.D., Analytical Chemistry. Microchemist, Commercial Solvents Corp., Terre Haute, Indiana.

Chenkin, Theodore, M.D., Clinical Investigation. Resident N. Y. U. Research Service, Goldwater Memorial Hosp., New York, N. Y.

Christensen, Gerald M., B.S., Metabolism. Univ. of Utah, Salt Lake City, Utah.

Cobe, Herbert Marshall, Ph.D., Bacteriology, Microbiology. Prof., Temple Univ., Philadelphia Pa.

Collett, James R., M.D., Medicine. Assist. Resident in Medicine, Bellevue Hosp., New York, N. Y.

de Brux, Jean André, M.D., Pathology, Histochemistry. Assist. in Pathology, Faculté de Médicine de Paris. Pathologist, Beaujon Hosp., Clichy, France.

Dimopoullos, George T., B.S., M.S., Virology, Biophysics. Predoctoral Fellow, Dept. of Bacteriology, Michigan State Coll., East Lansing, Mich.

Dixon, George P., E.E., Mathematics, Engineering. Exec. Secretary, Armed Forces Communications Assoc., Washington, C. D.

Dougherty, Ellsworth C., Ph.D., Biochemistry, Biochemical Genetics. Research Associate in Physiology, Univ. of Calif., Berkeley, Cal.

Engelhard, Warren E., B.S., M.S., Bacteriology, Research—Tuberculosis. Ohio State Univ., Columbus, Ohio.

Everall, John Dudley, MRCP, MRCS, LRCP., Dermatology. Leeds Univ., England.

Finck, Joseph Louis, Ph.D., Physics, Thermodynamics. Director, The J. L. Finck Labs., Brooklyn, N. Y.

Fleck, Stephen, M.D., Psychiatry. Assist. Prof., Univ. of Washington, Seattle, Wash.

Freedman, Leslie Henry, Inhalation Therapy. Technician, Nassau Hospital, L. I., N. Y.

Fuglister, Frederick C., Ocenography. Oceanographer, Woods Hole Institution, Mass.

Garey, John C., Ph.D., Microbiology, Biochemistry. Manager, Special Yeast Products Div., Red. Star Yeast & Products Co., Milwaukee, Wis.

Gellman, Sidney Z., M.D., Pathology, Internal Medicine. Pathologist, U. S. Naval Hospital, Portsmouth, N. H.

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Liddell, Howard Scott, Ph.D., Psychopathology. Prof. of Psychology, Cornell Univ., Ithaca, N. Y.

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McIntosh, B. J., Ph.D. Pharmacology. Assist. Prof. of Pharmacology, Univ. of Louisville, Ky.

Mahncke, Henry E., Ph.D., Physical Chemistry. Manager, Physical Chem. Section, Westinghouse Res. Labs., East Pittsburgh, Pa.

Marcson, Simon, Ph.D., Anthropology. Prof., Lecturer, Sociology, Anthropology, Brooklyn College, Brooklyn, N. Y.

Marcus, M. A., M.D., Cancer Research. Manhattan Gen. Hosp., New York, N. Y.

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STUDENT MEMBERSHIP

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